

CHAPTER 6

Output

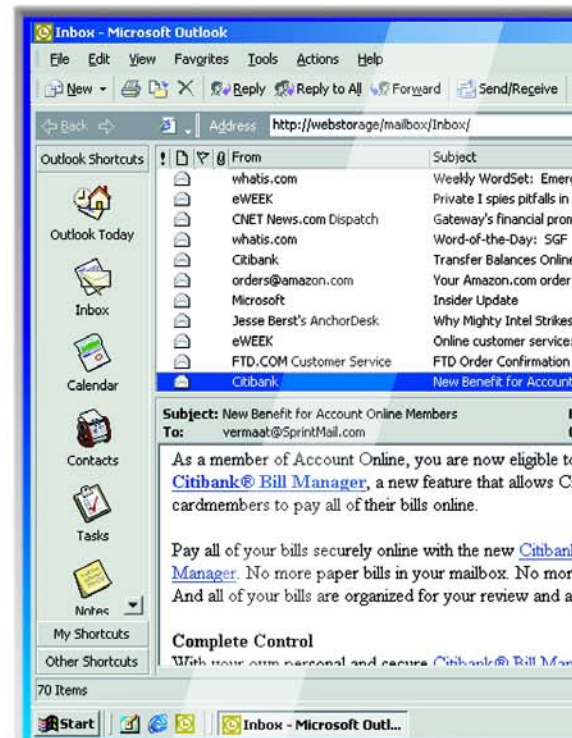
One day a week during a break between classes, you go home to make a nutritious lunch. You enjoy preparing meals now because your refrigerator's screen displays a digital cookbook with recipes suitable for the food currently stored in it.

The telephone rings as you sit down to eat. After taking the call, you turn to the refrigerator's door and press a button on its screen to record a video message: "John, the dealership called. Your car is ready. The number is 555-1029." When John returns home, he will retrieve the message you recorded.

With a few minutes to relax, you press a button on the refrigerator's screen to view your own video messages. John's face appears on the screen. He says, "Samantha called. She needs help with algebra." When the message ends, you press another button to watch the daily news directly on the refrigerator's screen.

Before heading back, you check your e-mail messages with the touch of a button; compose a message to Samantha pressing on-screen keyboard keys; and then reach for a soda.

This not-so-ordinary refrigerator has become communications central at your house. Now, if only your car could drive itself to school, you could study on the way!



WHAT IS OUTPUT?

OBJECTIVES

After completing this chapter, you will be able to:

- Define the four categories of output
- Identify the different types of display devices
- Describe factors that affect the quality of a monitor
- Identify monitor ergonomic issues
- Explain the differences among various types of printers
- Describe the uses of speakers and headsets
- Identify the purpose of data projectors, fax machines, and multifunction devices
- Explain how a terminal is both an input and output device
- Identify output options for physically challenged users

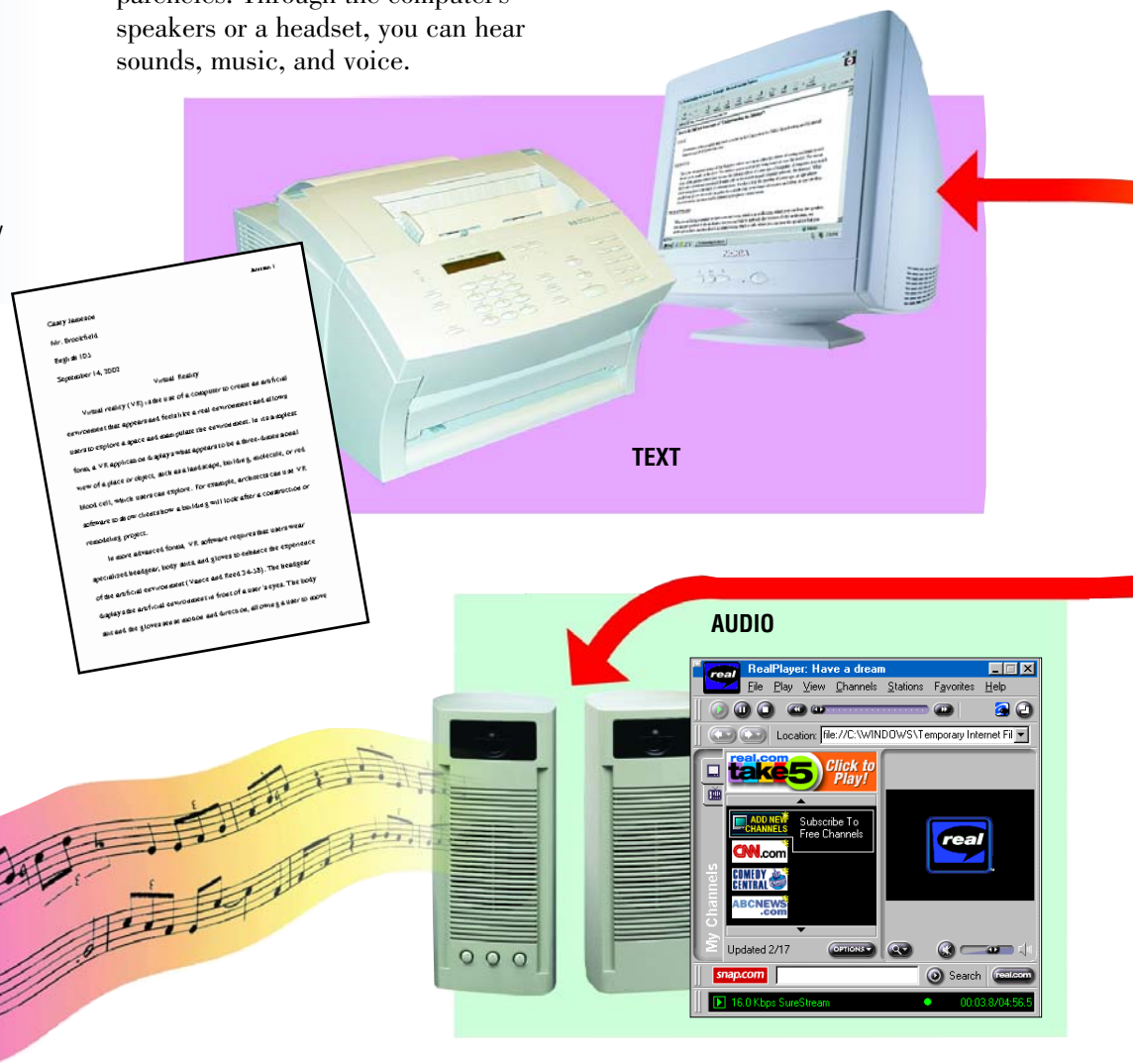
Output is data that has been processed into a useful form, called information. That is, computers process input into output. A computer generates several types of output, depending on the hardware and software being used and the requirements of the user.

You view, print, or hear output. Looking at a monitor on your desktop, you see information on the screen. Notebook computers, handheld computers, cellular telephones, and many other similar devices also have screens that allow mobile users to view information such as documents, Web sites, and e-mail messages while away from a desk. Some printers produce black-and-white documents. Others produce brilliant colors, so you can print color documents, photographs, and transparencies. Through the computer's speakers or a headset, you can hear sounds, music, and voice.

While using a computer, you will encounter four basic categories of output: text, graphics, audio, and video (Figure 6-1). Very often, documents and Web sites include more than one of these types of output.

- **Text** consists of characters that create words, sentences, and paragraphs. Examples of text-based documents are memorandums, letters, announcements, press releases, advertisements, newsletters, envelopes, and mailing labels.

By accessing the Web, you can view and print many other types of text-based documents. These include newspapers, magazines, books, play or television show transcripts, stock quotes, famous speeches, and historical lectures.



- A **graphic**, or **graphical image**, is a digital representation of non-text information such as a drawing, chart, and photograph. Many text-based documents include graphical images to enhance their visual appeal and convey information. Business letters have logos. Reports include charts. Newsletters use drawings, clip art, and photographs. You even can print high-quality photographs right from your digital camera, eliminating the need for film or film developers.

Many Web sites use animated graphics, giving images the appearance of motion. Some sites have simple animations such as blinking icons and scrolling messages. Others use sophisticated animations such as a simulation that shows how an avalanche starts.

- **Audio** is music, speech, or any other sound. You can put your favorite music CD in the CD-ROM or DVD-ROM drive and listen to the music while working on the computer. Many software programs such as games, encyclopedias, and simulations have musical accompaniments for entertainment and audio clips, such as narrations and speeches, to enhance understanding. For example, you can listen to Martin Luther King recite his “I Have a Dream” speech.

On the Web, you can tune into radio and television stations and listen to audio clips or live broadcasts of interviews, talk shows, sporting events, news, music, and concerts. You also can have a conversation with a friend, co-worker, or family member over the Web, just as if you were on the telephone.

- **Video** consists of full-motion images that are played back at various speeds. Most video also has accompanying audio. By attaching your video camera to the computer, you can watch home movies on the computer. You also can attach your television’s antenna or cable to your computer and watch your favorite television programs right on the computer.

As with audio, many software programs and Web sites include video clips to enhance your understanding. See doctors perform a life-saving surgery, watch a pre-recorded news report, observe a hurricane in action, or enjoy a live performance of your favorite jazz band — right on your computer!

Figure 6-1 Four common types of output are text, graphics, audio, and video.



WHAT ARE OUTPUT DEVICES?

An **output device** is any hardware component that can convey information to a user. Commonly used output devices include display devices, printers, speakers, headsets, data projectors, facsimile machines, and multifunction devices. The following pages discuss each of these output devices.

DISPLAY DEVICES

A **display device**, or simply **display**, is an output device that visually conveys text, graphics, and video information. Information on a display

device, sometimes called **soft copy**, exists electronically and displays for a temporary period of time.

The display device consists of the **screen**, or projection surface, and the components that produce the information on the screen. Many computers use a monitor as their display device. A **monitor** is a separate plastic or metal case that houses the screen. Most mobile computers, however, integrate the display and other components into the same physical case. For example, the display on a notebook computer attaches with a hinge, and the display on a handheld computer is part of the computer case.

Most display devices project text, graphics, and video information in color (Figure 6-2). Some, however,

are monochrome. **Monochrome** means the information displays in one color (such as white, amber, green, black, blue, or gray) on a different color background, possibly black or grayish-white. Some handheld computers and devices use monochrome displays to save on battery power. To enhance the quality of their graphics, monochrome displays often use gray scaling. **Gray scaling** involves using many shades of gray from white to black, which provides better contrast on the images.

Web Link

For more information on monitors, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Monitors.



The Paper Chase

Use a Display Device instead of a Printer

In 1975, George Pake, the head of Xerox Corporation's Research Center in Palo Alto, California, predicted the use of printed paper would decline dramatically as offices turned to electronic files accessed at the touch of a button. Futurist Alvin Toffler wrote in 1970 that making paper copies of anything is a primitive use of machines and violates their very spirit. Instead of these predictions coming true, the opposite happened. Paper use has risen more than 40 percent during the past 30 years. Statistics indicate a major portion of this increase is tied directly to e-mail. Additionally, every office has computer printers, copy machines, and facsimile machines that reproduce documents at an ever-increasing rate. Can and should people and organizations try to reduce paper use? Why or why not? If society cannot create a paperless office, what can be done to promote a less-paper office?

For more information on the paperless office, visit the Discovering Computers 2002 Issues Web page (scsite.com/dc2002/issues.htm) and click Chapter 6 Issue #1.



Figure 6-2 Most desktop monitors display information in color.

Display devices include CRT monitors, LCD monitors and displays, gas plasma monitors, and televisions. The following sections describe each of these display devices.

CRT Monitors

A **CRT monitor** is a monitor that is similar to a standard television set because it contains a cathode ray tube (Figure 6-3). A **cathode ray tube (CRT)** is a large, sealed, glass tube. The front of the tube is the screen. Tiny dots of phosphor material coat the screen on a CRT. Each dot consists of a red, a green, and a blue phosphor. The three dots combine to make up each pixel. Recall from Chapter 5 that a **pixel** (short for *picture element*) is a single point in an electronic image. Inside the CRT, an electron beam moves back and forth across the back of the screen. This causes the dots on the front of the screen to glow, which produces an image on the screen.

CRT monitors for desktop computers are available in various sizes, with the more common being 15, 17, 19, 21, and 22 inches. You measure a monitor diagonally, from one corner of

the casing to the other. In addition to monitor size, advertisements also list a monitor's viewable size. The **viewable size** is the diagonal measurement of the actual viewing area provided by the monitor. A 21-inch monitor, for example, may have a viewable size of only 19.8 inches.

Determining what size monitor to use depends on your intended use. A large monitor allows you to view more information on the screen at once, but usually is more expensive. If you work on the Web or use multiple applications at one time, you may want to invest in a 19-inch monitor. If you use your computer for intense graphing applications, such as desktop publishing and engineering, you may want an even larger monitor.

In the past, CRT monitor screens were curved slightly. Current models have flat screens. A flat screen reduces glare, reflection, and distortion of images. With a flat screen, you will not have as much eyestrain and fatigue. Thus, a flat screen is an ergonomic screen. Recall from Chapter 5 that the goal of ergonomics is to incorporate comfort, efficiency, and safety into the design of items in the workplace.

LCD Monitors and Displays

LCD monitors and **LCD displays** use liquid crystal, instead of a cathode ray tube, to present information on the screen. A **liquid crystal display (LCD)** has liquid crystals between two sheets of material. When an electric current passes through the crystals, they twist. This causes some light waves to be blocked and allows others to pass through, which creates the images on the screen.

LCD monitors and LCD displays are a type of flat-panel display. A **flat-panel display** has a lightweight, compact screen that consumes less than one-third of the power than does a CRT monitor. This feature makes the LCD monitors and displays ideal for mobile users or users with space limitations.

Like CRT monitors, LCD monitors are available in a variety of sizes, with the more common being 15, 17, 18, and 20 inches. LCD monitors have a much smaller footprint than do traditional CRT monitors; that is, they take up much less desk space (Figure 6-4). You even can mount some LCD monitors on the wall for increased space savings. LCD monitors typically are more expensive than CRT monitors.

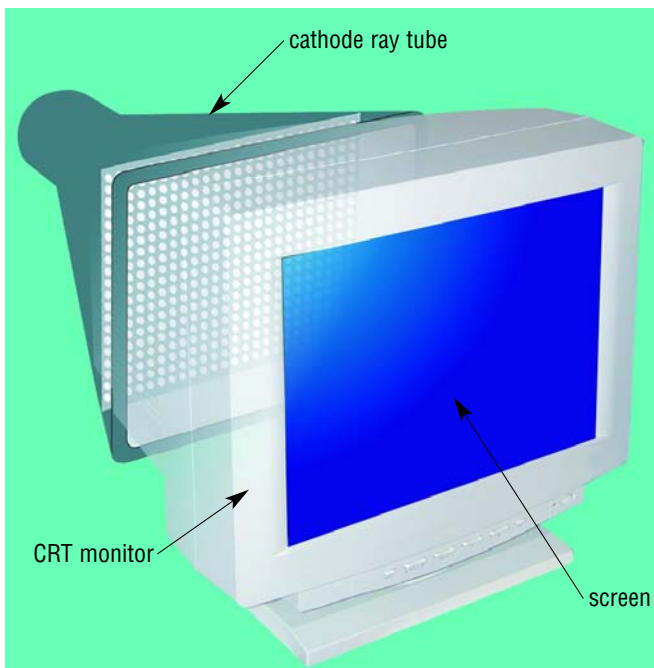


Figure 6-3 The core of many desktop monitors is a cathode ray tube.



Figure 6-4 An LCD monitor is much thinner and lighter than a CRT monitor.

Many current LCD monitors have built-in television tuners. These monitors allow you to watch television programs without having to install a TV tuner card in the system unit. Simply plug your television antenna or cable into the port on the monitor.

Notebook and handheld computers often use LCD displays. The display device is built into these mobile computers (Figure 6-5). The LCD displays for notebook computers are available in a variety of sizes, with the more common being 14.1, 15.0, and 15.4 inches.

Many Web-enabled devices such as cellular telephones and pagers also use LCD displays (Figure 6-6).



Figure 6-5 Notebook computers have a color LCD display. Some handheld computers even have color displays.

Web Link

For more information on Web-enabled devices, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scs.site.com/dc2002/ch6/weblink.htm) and click Web-enabled Devices.

COMPANY ON THE CUTTING EDGE



Wireless Products for Web Access

The next time you listen to your favorite radio station in your car, give thanks to Paul and Joseph Galvin for making it possible. These two brothers developed the first practical and affordable car radio and created the Galvin Manufacturing Corporation in Chicago in 1928.

Paul Galvin named the company's products Motorola, combining the ideas of motion and radio. This trademark became so familiar that the company officially changed its name in 1947. Although the corporation branched out into other products, such as two-way radios for the military and for police departments, televisions, and microprocessor chips, its development of early communications devices made them the formidable leader they are today in wireless communications.

Today, Motorola's wireless telephones and word pagers allow you to receive Internet content, send e-mail, and connect to personal and company databases. Mya, the cyber-generated personal assistant, even will read you your e-mail, appointments, and weather and traffic reports.

For more information on Motorola, visit the Discovering Computers 2002 Companies Web page (scs.site.com/dc2002/companies.htm) and click Motorola.



Figure 6-6 Most handheld Web-enabled devices such as cellular telephones and pagers use LCD displays. These devices provide access to the Internet and/or e-mail.

A Web-enabled device is a device that provides access to the Web and/or e-mail. Many Web-enabled handheld computers and devices use monochrome displays to save battery power. Some handheld computers, however, do have a color display.

Another popular handheld Web-enabled device that uses an LCD screen is an electronic book. An **electronic book (e-book)** is a small, book-sized computer that allows users to read, save, highlight, bookmark, and add notes to online text (Figure 6-7). You download new book content to your e-book from the Web.

To improve the quality of reading material on LCD screens, such as an e-book, Microsoft has developed a new technology called ClearType. The goal of **ClearType** is to make onscreen reading as natural as reading from printed material.

ISSUE

Read any Good E-Books Lately?

Electronic Books

Imagine a library on your lap. Read your favorite Stephen King novel, delete it, and download the complete works of Hemingway. The electronic book (e-book) has arrived. Analysts predict electronic books will revolutionize the publishing industry. An electronic book is primarily a digital storage and display unit. This small, handheld device plugs into a cradle that attaches to your computer, letting you download textbooks or novels from Web-based publishers. Some of these include a built-in modem that allows you to connect directly to the Internet. They range in size and weight from a paperback to a two-pound textbook and can hold thousands of pages or the equivalent to 10 or more books. Keeping with some traits of traditional books, you can move forward or backward one page at a time, or use a stylus to write notes in the margin. What is your opinion of the electronic book? Will it replace the printed book? Why not just buy the book? Is there a place in society for the electronic book? Who will use electronic books and how will they use them?

For more information on electronic books, visit the Discovering Computers 2002 Issues Web page (scsite.com/dc2002/issues.htm) and click Chapter 6 Issue #2.



Figure 6-7 E-books typically use an LCD display. You can read books, magazines, newspapers, Web pages, or any other printed material on an e-book, which is about the size of a paperback book.

LCD monitors and displays produce color using either passive matrix or active matrix technology. An **active-matrix display**, also known as a **thin-film transistor (TFT) display**, uses a separate transistor for each color pixel and thus can display high-quality color that is viewable from all angles. Active-matrix displays require more power than passive-matrix displays because they use many transistors.

A **passive-matrix display**, now often called a **dual-scan display**, uses fewer transistors and requires less power than an active-matrix display. The color on a passive-matrix display often is not as bright as an active-matrix display. You can view images on a passive-matrix display best when working directly in front of the display. The latest passive-matrix displays use **high-performance addressing (HPA)**, which provide

image quality near that of TFT displays. Passive-matrix displays are less expensive than active-matrix displays.

Gas Plasma Monitors

For even larger displays, some large business or power users prefer gas plasma monitors, which can measure more than 42 inches wide (Figure 6-8). Many of these monitors also can hang directly on a wall.

A **gas plasma monitor** is a flat-panel display that uses gas plasma technology, which substitutes a layer of gas for the liquid crystal material in an LCD monitor. When voltage is applied, the gas releases ultraviolet (UV) light. This UV light causes the pixels on the screen to glow and form an image. Gas plasma monitors offer larger screen sizes and higher display quality than LCD monitors but are much more expensive.

Quality of Display Devices

The quality of a monitor or display depends largely on its resolution, dot pitch, and refresh rate. As described in Chapter 5, **resolution** describes the sharpness and clearness of an image. Manufacturers state the resolution of a display device as dots, or pixels. The greater the number of pixels the display uses, the better the quality of the image. For example, an 800 x 600 monitor can display up to 800 horizontal pixels and 600 vertical pixels, for a total of 480,000 pixels to create a screen image. Most monitors today can display up to 1280 x 1024 pixels, with 800 x 600 typically the standard. High-end monitors can display up to 2048 x 1536 pixels.



Figure 6-8 Large gas plasma monitors can measure more than 42 inches wide.

Displays with higher resolutions use a greater number of pixels, providing a smoother image. As the resolution increases, however, the images on the screen appear smaller (Figure 6-9). For this reason, you would not use a high resolution on a small display, such as a 15-inch monitor, because the small characters would be difficult to read. The display resolution you choose is a matter of preference. Larger monitors typically use a higher resolution, and smaller monitors use a lower resolution. For example, a 21-inch monitor may use a 1600 x 1200 resolution, and a 17-inch monitor may use a resolution of 800 x 600. A higher resolution also is desirable for graphics applications. A lower resolution usually is satisfactory for business applications such as word processing.

Dot pitch is another factor which you can use to measure image clarity. **Dot pitch**, sometimes called **pixel pitch**, is the distance between each pixel on a display. The smaller the distance between the pixels, the sharper the image. Text created with a smaller dot pitch is easier to read. To minimize eye fatigue, you should use a monitor with a dot pitch of .29 millimeters or lower.

Refresh rate is yet another factor in a monitor's quality. **Refresh rate**, also called **vertical frequency** or **vertical scan rate**, is the speed that a monitor redraws images on the screen. Ideally, a monitor's refresh rate should be fast enough to maintain a constant, flicker-free image. A slower refresh rate causes the image to fade and then flicker as it is redrawn. This flicker can lead to eye fatigue and cause headaches for users. Refresh rate is measured according to **hertz**, which is the number of times per second the screen is redrawn. Although most people can tolerate a refresh rate of 60 hertz, a high-quality monitor will provide a refresh rate of at least 75 hertz. This means the image on the screen redraws itself 75 times in a second.

Figure 6-9a (screen resolution at 800 x 600)



Figure 6-9b (screen resolution at 1024 x 768)



Figure 6-9 The higher a screen's resolution, the smaller the images display on the screen. This figure illustrates that all elements on the screen become smaller when the resolution is increased from 800 x 600 to 1024 x 768. Notice also that more text displays on the screen with the higher resolution.

Video Cards and Monitors

To display color on a monitor, the computer sends a signal through the video card in the system unit. A **video card**, also called a **graphics card** or **video adapter**, converts digital output from the computer into an analog video signal and sends the signal through a cable to the monitor. How the display device produces the picture varies depending on the type of display.

CRT monitors use the analog signal to produce a picture (Figure 6-10). LCD monitors use a digital signal to produce a picture. The LCD monitor contains circuitry that converts the analog signal from the video card back to a digital signal. This is one reason why LCD monitors are more expensive than CRT monitors. Ideally, an LCD monitor should plug into a digital interface on the computer. The **Digital Display Working Group (DDWG)**, which is led by several industry companies, is developing a standard interface for all displays. This new digital interface, called the **Digital Video Interface (DVI)**, provides connections for both CRT and LCD monitors.

The number of colors a video card can display is determined by its bit depth. The video card's **bit depth**, also called the **color depth**, is the number of bits it uses to store information about each pixel. For example, an 8-bit video card (also called 8-bit color) uses 8 bits to store information about each pixel. Thus, this video card can display 256 different colors (computed as 2^8 or $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$). A 24-bit video card uses 24 bits to store information about each pixel and can display 2^{24} or 16.7 million colors. The greater the number of bits, the better the resulting image.

Over the years, several video standards have been developed to define the resolution, number of colors, and other display properties. Today, the **Video Electronics Standards Association (VESA)**, which consists of video card and

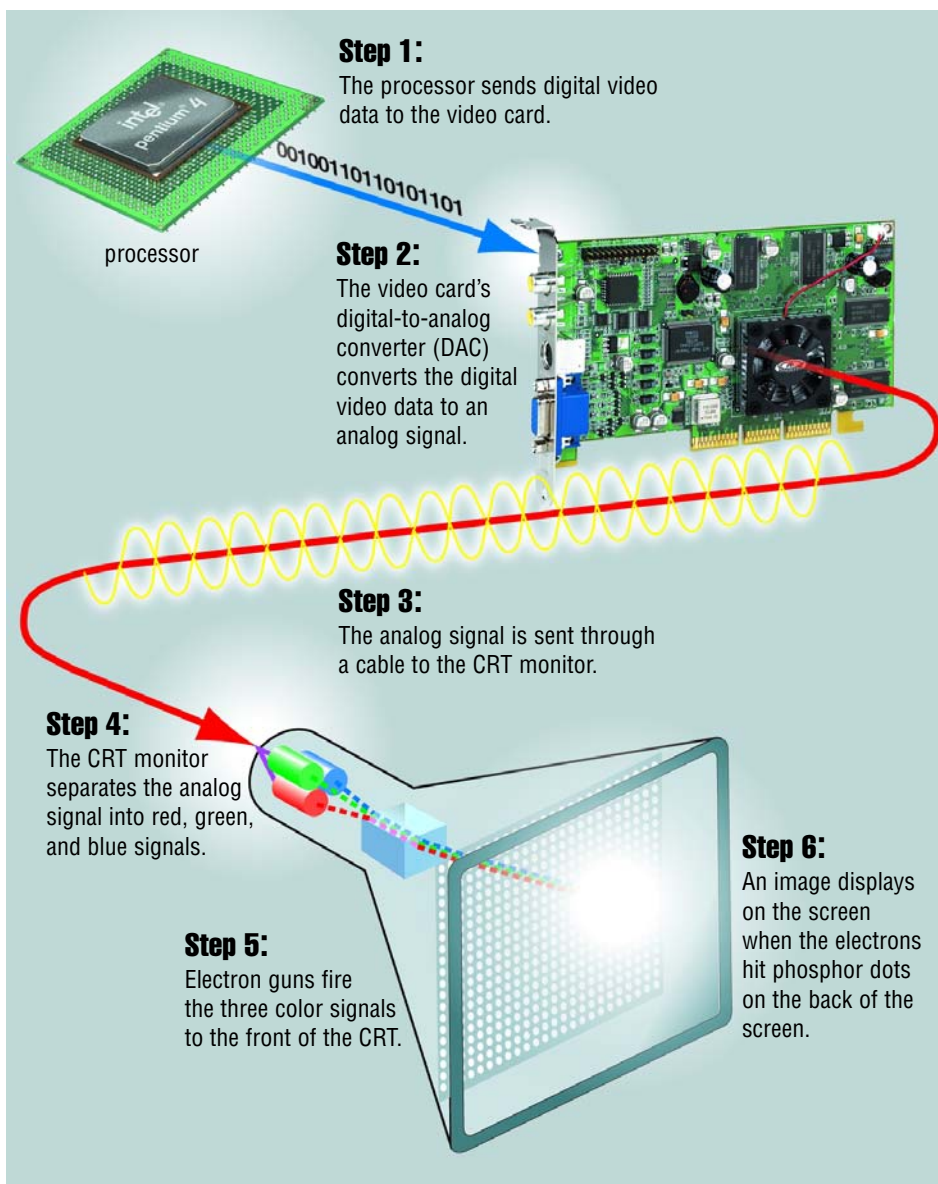
monitor manufacturers, develops video standards. Most current video cards support the **super video graphics array (SVGA)** standard, which also supports resolutions and colors in the VGA standard. The table in Figure 6-11 outlines the suggested resolution and number of displayed colors in the MDA, VGA, XGA, SVGA, and beyond SVGA standards.

For a monitor to display images using the resolution and number of colors defined by a video standard, the monitor must support the same video standard *and* the video card must be capable of communicating appropriate signals to the monitor.

Both the video card and the monitor must support the video standard to generate the desired resolution and number of colors.

Your video card also must have enough memory to generate the resolution and number of colors you want to display. The memory in video cards stores information about each pixel. Video cards use a variety of video memory: VRAM, WRAM, SGRAM, or SDRAM. Manufacturers state video memory in megabytes. The table in Figure 6-12 outlines the amount of video memory required for various screen resolutions and color depth configurations. For example, if you

Figure 6-10 HOW VIDEO TRAVELS FROM THE PROCESSOR TO A CRT MONITOR



wanted an 800 x 600 resolution with 24-bit color (16.7 million colors), then your video card should have at least 2 MB of video memory.

Monitor Ergonomics

The goal of ergonomics is to incorporate comfort, efficiency, and safety into the design of items in the workplace. Many monitors have features that help address ergonomic issues. Most monitors have a tilt-and-swivel base, so you can adjust the angle of the screen to minimize neck strain and reduce glare from overhead lighting.

Monitors also have controls that allow you to adjust the brightness, contrast, positioning, height, and width of images. These controls usually are on the front of the monitor for easy access. Newer monitors have digital controls that allow you to fine-tune the display in small increments. An advantage of digital controls is you quickly can return to the default settings by pressing the reset button.

CRT monitors produce a small amount of electromagnetic radiation. **Electromagnetic radiation (EMR)** is a magnetic field that travels at the speed of light. No solid evidence exists to prove that EMR poses a health risk. To be safe, however, all high-quality CRT monitors comply

with MPR II standards. **MPR II** is a set of standards that defines acceptable levels of EMR for a monitor. To protect yourself even further, sit at arm's length from the CRT monitor because EMR only travels a short distance. In addition, EMR is greatest on the sides and back of the CRT monitor. LCD monitors do not pose this risk.



Your desktop computer can cause you more problems than you know. Many computer users are unaware of computer vision syndrome (CVS). The Mayo Clinic (see URL below) advises that if you have some or all of these symptoms, you may have CVS: sore, tired, burning, itching or dry eyes; blurred or double vision; distance vision blurred after prolonged staring at monitor; headache or sore neck; difficulty shifting focus between monitor and source documents; difficulty focusing on the screen image; color fringes or afterimages when you look away from the monitor; and increased sensitivity to light. Although eyestrain associated with CVS is not thought to have serious or long-term consequences, it is disruptive and unpleasant.

Following are some hints that may help ease the strain:

- Take an eye break – every 10 minutes or so, look away from the monitor
- Close your eyes and rest them for at least a minute
- Blink your eyes – the Mayo Clinic suggests blinking every five seconds
- Place your monitor about an arm's length away from your eyes with the top of the screen at eye level or below
- Use a glare screen
- Use large fonts
- If you wear glasses, ask your doctor for computer glasses
- Adjust the lighting

For links to computer health issues and the Web site mentioned above, visit the Discovering Computers 2002 Apply It Web page (scsite.com/dc2002/apply.htm) and click Chapter 6 Apply It #1.

VIDEO STANDARDS

Standard	Suggested Resolution	Possible Simultaneous Colors
Monochrome Display Adapter (MDA)	720 x 350	1 for text
Video Graphics Array (VGA)	640 x 480	16
	320 x 200	256
Extended Graphics Array (XGA)	1024 x 768	256
	640 x 480	65,536
Super Video Graphics Array (SVGA)	800 x 600	16.7 million
	1024 x 768	16.7 million
	1280 x 1024	16.7 million
	1600 x 1200	16.7 million
Beyond SVGA	1920 x 1440	16.7 million
	2048 x 1536	16.7 million

Figure 6-11 The various video standards.

VARIOUS VIDEO CARD CONFIGURATIONS

Video Memory	Color Depth	Number of Colors	Resolution
1 MB	8-bit	256	1024 x 768
	16-bit	65,536	800 x 600
2 MB	8-bit	256	1024 x 768
	16-bit	65,536	1280 x 1024
	24-bit	16.7 million	800 x 600
4 MB	24-bit	16.7 million	1024 x 768
6 MB	24-bit	16.7 million	1280 x 1024
8 MB	32-bit	16.7 million	1600 x 1200
16 MB	32-bit	16.7 million	1920 x 1440
32 MB	32-bit	16.7 million	2048 x 1536

Figure 6-12 The amount of video memory required for various screen resolutions.

To help reduce the amount of electricity used by monitors and other computer components, the United States Department of Energy (DOE) and the United States Environmental Protection Agency (EPA) developed the **ENERGY STAR program**. This program encourages manufacturers to create energy-efficient devices that require little power when they are not in use. Monitors and devices that meet ENERGY STAR guidelines display an ENERGY STAR® label (Figure 6-13).

Televisions

Many home and business users have a television set as a monitor for their computer. Connecting a computer to a standard television set requires an **NTSC converter**, which converts the digital signal from the computer into an analog signal that the television set can display. NTSC stands for **National Television Standards Committee** and consists of industry members that have technical expertise about television-related issues.

High-definition television (HDTV) is a type of television set that works with digital broadcasting signals and supports a wider screen and higher resolution display than a standard television set. With HDTV, the broadcast signals are digitized when they are sent. Digital television signals provide two major advantages over analog signals. First, digital signals produce a higher-quality picture. Second, many programs

can be broadcast on a single digital channel, whereas only one program can be broadcast on an analog channel. Currently, only a few U.S. television stations broadcast digital signals. By 2006, all stations must be broadcasting digital signals, as mandated by the FCC.

As the cost of HDTV becomes more reasonable, home users will begin to use it as their computer's display device. HDTV also is ideal for presenting material to a large group.

HDTV technology also makes interactive TV more feasible. **Interactive TV** is a two-way communications technology in which users interact with television programming. Instead of adding special equipment to your standard television, HDTV works directly with interactive TV. Uses of interactive TV include selecting a movie from a central library of movies, voting or responding to network questionnaires, banking and shopping, and playing games.

PRINTERS

A **printer** is an output device that produces text and graphics on a physical medium such as paper or transparency film. Printed information, called **hard copy**, exists physically and is a more permanent form of output than that presented on a display device (soft copy).

A hard copy, also called a **printout**, can be portrait or landscape orientation (Figure 6-14). A page in **portrait orientation** is taller than it is wide, with information printed across the shorter width of the paper. A page in **landscape orientation** is wider than it is tall, with information printed across the widest part of the paper. Letters, reports, and books typically use portrait orientation. Spreadsheets, slide shows, and graphics often use landscape orientation.



EPA POLLUTION PREVENTER

Figure 6-13 Products with an Energy Star label are energy efficient as defined by the Environmental Protection Agency (EPA).

Figure 6-14a (portrait orientation)

**Play Auditions...
... for Grease!**

HARBOR THEATRE COMPANY

The Harbor Theatre Company is seeking talented actors for singing, and dancing roles in *Grease* for roles in *Grease* Alumni Hall.

Only Harbor College students may audition for roles in the play. Bring your resume and a recent photo to the audition.

To schedule an audition, call 555-1234.

Figure 6-14 Portrait orientation is taller than it is wide. Landscape orientation is wider than it is tall.

Figure 6-14b (landscape orientation)

Lite Power Company					
Quarterly Company Receipts and Expenditures					
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Total
Revenue					
Natural Gas	\$52,349,812.00	\$67,213,943.00	\$55,329,781.00	\$51,690,855.00	\$226,584,191.00
Electricity	42,812,562	55,392,887	52,932,856	50,278,541	201,416,846
Total Revenue	\$95,162,374.00	\$122,606,830.00	\$108,262,637.00	\$101,969,396.00	\$428,001,037.00
Expenditures					
Marketing	\$12,133,203	\$15,632,371	\$13,803,486	\$13,001,072	\$54,570,132
Payroll	31,070,515	40,031,130	35,347,751	33,292,942	139,742,339
Equipment	13,608,219	17,532,777	15,481,557	14,581,595	61,204,148
Production	18,556,663	23,908,332	21,111,214	19,883,993	83,460,202
Administrative	4,282,307	5,517,307	4,871,819	4,589,814	19,260,047
Total Expenditures	\$79,650,907	\$102,621,917	\$90,615,827	\$85,348,217	\$358,236,868
Net income	\$15,511,467	\$19,984,913	\$17,646,810	\$16,620,979	\$69,764,169
Assumptions					
Marketing	12.75%				
Payroll	32.55%				
Equipment	14.30%				
Production	19.50%				
Administrative	4.50%				

Home computer users might print a hundred pages or fewer a week. Small business computer users might print several hundred pages a day. Users of mainframe computers, such as large utility companies that send printed statements to hundreds of thousands of customers each month, require printers that are capable of printing thousands of pages per hour.

To meet this range of printing needs, many different printers exist with varying speeds, capabilities, and printing methods. Figure 6-15 presents a list of questions to help you decide on the printer best suited to your needs.

Many printers today handle Internet printing. With **Internet printing**, an Internet service on the Web sends a print instruction to your printer, which may be at a location different from your computer or device that accessed the Web site (Figure 6-16). A printer with Internet printing capability can receive print instructions from an Internet printing service so it can print documents from desktop and wireless computers and devices, such as cellular telephones. For example, you can print items such as postage, package shipping labels, newspaper articles, and event tickets from a Web-enabled cellular telephone. The goal of Internet printing is to make every computer and Web-enabled device capable of printing.

Generally, printers are either impact or nonimpact. The following pages discuss printers in both of these categories.

1. How fast must my printer print?
2. Do I need a color printer?
3. What is the cost per page for printing?
4. Do I need multiple copies of documents?
5. Will I print graphics?
6. Do I want to print photographs?
7. What types of paper does the printer use?
8. What sizes of paper does the printer accept?
9. How much paper can the printer tray hold?
10. Will the printer work with my computer and software?
11. How much do supplies such as ink and paper cost?
12. Can the printer print on envelopes and transparencies?
13. What is my budget?
14. How much do I print now, and what will I be printing in a year or two?

Figure 6-15 Questions to ask when purchasing a printer.

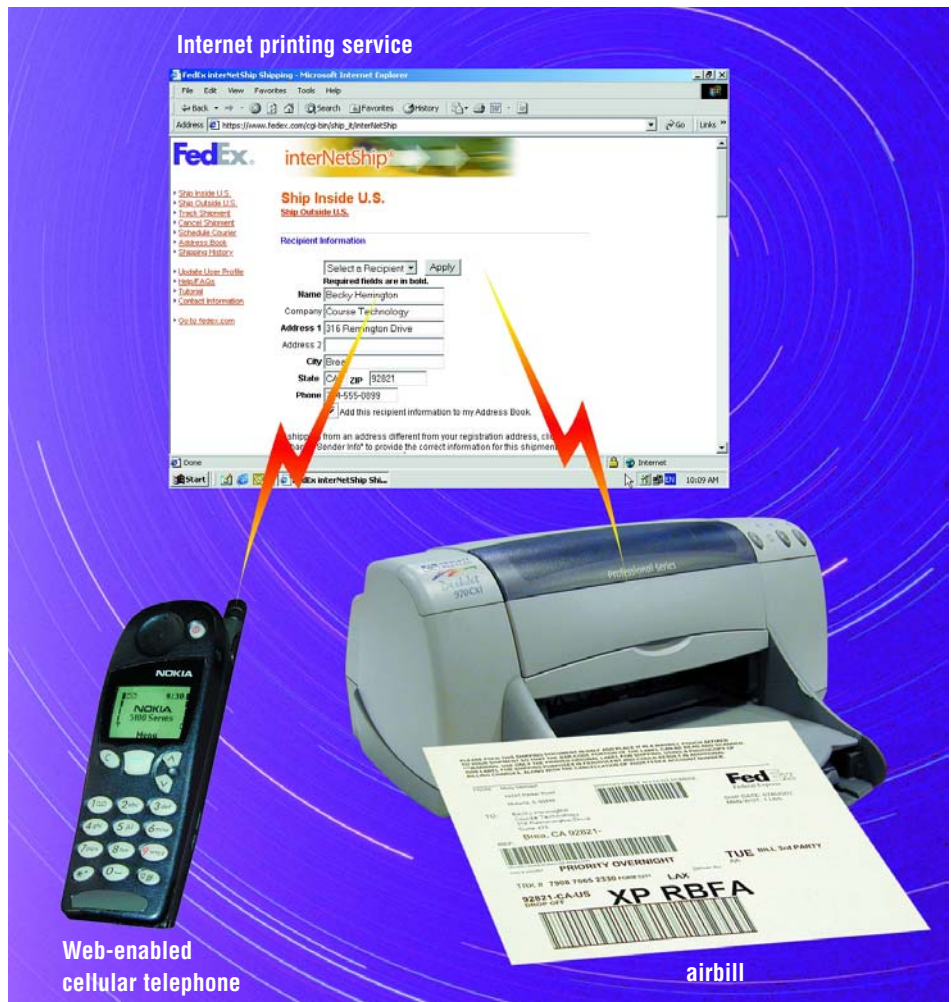


Figure 6-16 Internet printing allows printers to print documents from desktop and wireless computers and devices. The device sends the print instruction to an Internet service, which sends the print instruction to the printer.

Impact Printers

An **impact printer** forms characters and graphics on a piece of paper by striking a mechanism against an ink ribbon that physically contacts the paper. Impact printers generally are noisy because of this striking activity.

Impact printers typically do not provide letter quality print. **Letter quality (LQ)** output is a quality of print acceptable for business letters. Many impact printers produce **near letter quality (NLQ)** print, which is slightly less clear than letter quality. Some companies use NLQ impact printers for routine jobs such as printing mailing labels, envelopes, and invoices.

Impact printers are ideal for printing multipart forms because they easily can print through many layers of paper. Factories and retail counters use impact printers because these printers can withstand dusty environments, vibrations, and extreme temperatures.

Two commonly used types of impact printers are dot-matrix printers

and line printers. The following paragraphs discuss each of these printers.

DOT-MATRIX PRINTERS

A **dot-matrix printer** is an impact printer that produces printed images when tiny wire pins on a print head mechanism strike an inked ribbon (Figure 6-17). When the ribbon presses against the paper, it creates dots that form characters and graphics.

Most dot-matrix printers use **continuous-form paper**, in which each sheet of paper is connected together. The pages have holes along the sides to help feed the paper through the printer. Perforations along the inside of the holes and at each fold allow you to separate the sheets into standard-sized sheets of paper, such as 8½-by-11-inches. With continuous-form paper, you do not have to change the paper often because thousands of sheets are connected together. You also can adjust many dot-matrix printers to print pages in either portrait or landscape orientation.

The print head mechanism on a dot-matrix printer can contain 9 to 24 pins, depending on the manufacturer and the printer model. A higher number of pins means the printer prints more dots per character, which results in higher print quality.

The speed of a dot-matrix printer is measured by the number of characters per second (cps) it can print. The speed of dot-matrix printers ranges from 50 to 700 characters per second (cps), depending on the desired print quality.

LINE PRINTERS A **line printer** is a high-speed impact printer that prints an entire line at a time (Figure 6-18). The speed of a line printer is measured by the number of lines per minute (lpm) it can print. These printers are capable of printing up to 3,000 lines per minute (lpm).

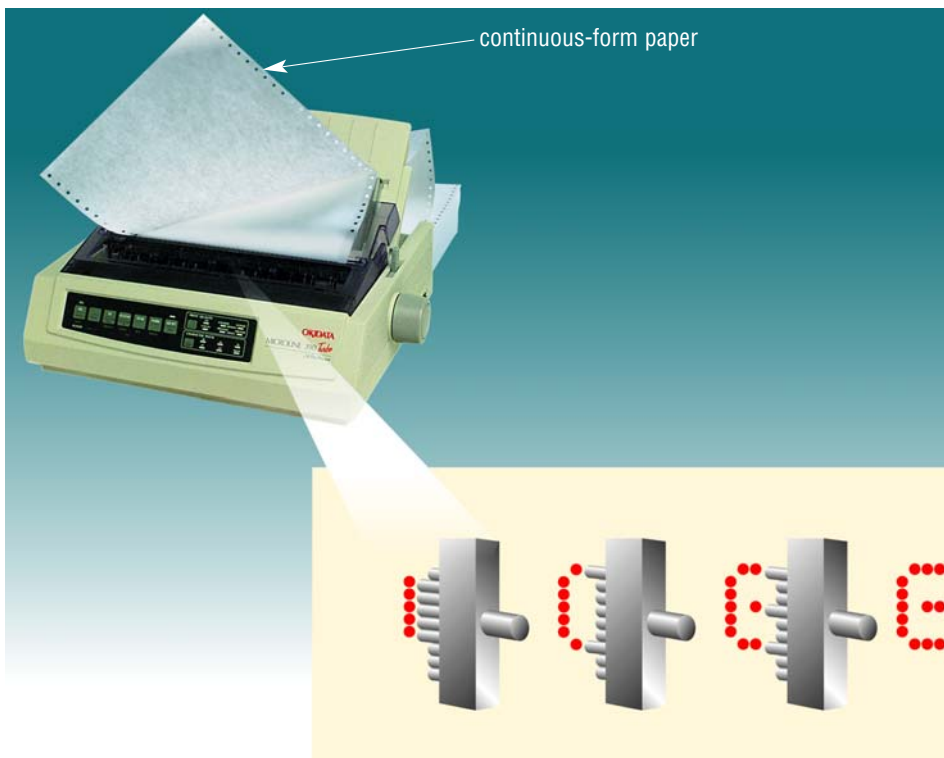


Figure 6-17 A dot-matrix printer produces printed images when tiny pins strike an inked ribbon.



Figure 6-18 A line printer is a high-speed printer often connected to a mainframe, mid-range server, or network.

Mainframes, mid-range servers, or networked applications, such as manufacturing, distribution, or shipping, often use line printers. These printers typically use 11-by-17-inch continuous-form paper. For example, mainframe computers often use greenbar paper to print reports.

Two popular types of line printers used for high-volume output are band and shuttle-matrix. A **band printer** prints fully-formed characters when hammers strike a horizontal, rotating band that contains shapes of numbers, letters of the alphabet, and other characters. A shuttle-matrix printer works more like a dot-matrix printer. The difference is the **shuttle-matrix printer** moves a series of print hammers back and forth horizontally at incredibly high speeds, as compared to standard line printers. Unlike a band printer, a shuttle-matrix printer can print characters in various fonts and font sizes.

Nonimpact Printers

A **nonimpact printer** forms characters and graphics on a piece of paper without actually striking the paper. Some spray ink, while others use heat and pressure to create images. Because these printers do

not strike the paper, they are much quieter than the previously discussed impact printers.

Three commonly used types of nonimpact printers are ink-jet printers, laser printers, and thermal printers. The following sections discuss each of these printers.

Ink-Jet Printers

An **ink-jet printer** is a type of nonimpact printer that forms characters and graphics by spraying tiny drops of liquid ink onto a piece of paper. Ink-jet printers usually use individual sheets of paper stored in a removable or stationary tray.

Ink-jet printers can produce letter-quality text and graphics in both black-and-white and color print on a variety of paper types (Figure 6-19). Available paper types include plain paper, ink-jet, photo paper, glossy paper, and banner paper. Some ink-jet printers can print photographic-quality images on any of these types of paper. Others require the heavier weight ink-jet paper for better-looking color documents.

These printers also print on other materials such as envelopes, labels, index cards, greeting card paper, transparencies, and iron-on

t-shirt transfers. Many ink-jet printers include software for creating greeting cards, banners, business cards, letterheads, and transparencies.

Ink-jet printers have become the most popular type of color printer for use in the home because of their lower cost and letter-quality print. You can purchase an ink-jet printer of reasonable quality for a few hundred dollars.

As with many other input and output devices, one factor that determines the quality of an ink-jet printer is its resolution, or sharpness and clarity. Printer resolution is measured by the number of dots per inch (dpi) a printer can output. As shown in Figure 6-20, the higher the dpi, the better the print quality. With an ink-jet printer, a dot is a drop of ink. A higher dpi means the drops of ink are smaller, which provides a higher quality image. Most ink-jet printers have a dpi that ranges from 300 to 2,400 dpi. Printers with a higher dpi usually are more expensive.

The speed of an ink-jet printer is measured by the number of pages per minute (ppm) it can print. Most ink-jet printers print from 1 to 12 pages per minute (ppm). Graphics and colors print at the slower rate.



Figure 6-19 Ink-jet printers are the most popular type of color printer used in the home.

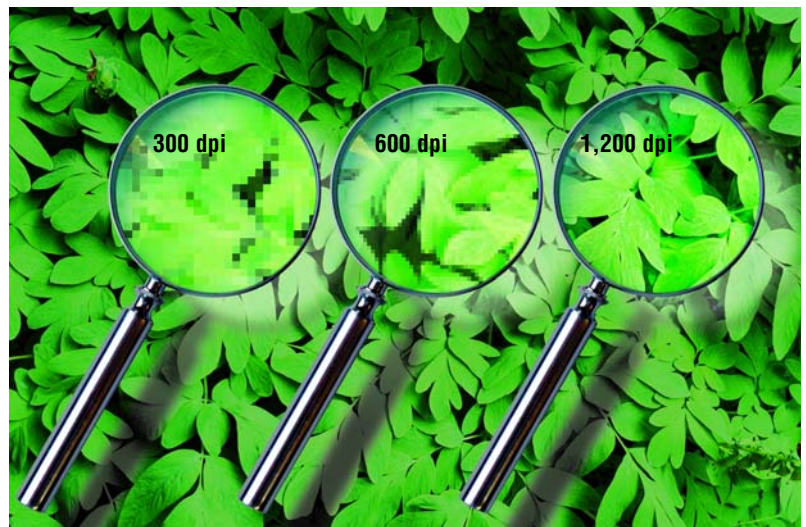


Figure 6-20 The higher the dpi, the better the quality of the image.

The print head mechanism in an ink-jet printer contains ink-filled print cartridges. Each cartridge has fifty to several hundred small ink holes, or nozzles. The steps in Figure 6-21 illustrate how a drop of ink appears on a page. Each nozzle in the print cartridge is similar to an individual pin on a dot-matrix printer. Just as any combination of dot-matrix pins can be activated, heat or pressure propels ink through any combination of the nozzles to form a character or image on the paper.

Web Link

For more information on ink-jet printers, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/webink.htm) and click Ink-Jet Printers.

When the print cartridge runs out of ink, you simply replace the cartridge. Most ink-jet printers have at least two print cartridges: one containing black ink and the other(s) containing colors. These cartridges usually cost from \$20 to \$40 per cartridge. The number of pages you can print from a single cartridge varies by manufacturer. Some print as few as 20 pages, while others print as many as 300 pages.

On average, it costs from \$.03 to \$.05 per page for black ink and \$.10 to \$.15 per page for color ink. When coupled with premium photo paper, the cost for a high-quality photograph can increase to about \$1.00 per page.

Laser Printers

A **laser printer** is a high-speed, high-quality nonimpact printer (Figure 6-22). Laser printers for personal computers usually use individual sheets of paper stored in a removable tray that slides into the printer case. Some laser printers have trays that can accommodate different sizes of paper, while others require separate trays for letter- and legal-sized paper. Most laser printers have a manual feed slot where you can insert individual sheets and envelopes. You also can print transparencies on a laser printer.

Figure 6-21 HOW AN INK-JET PRINTER WORKS

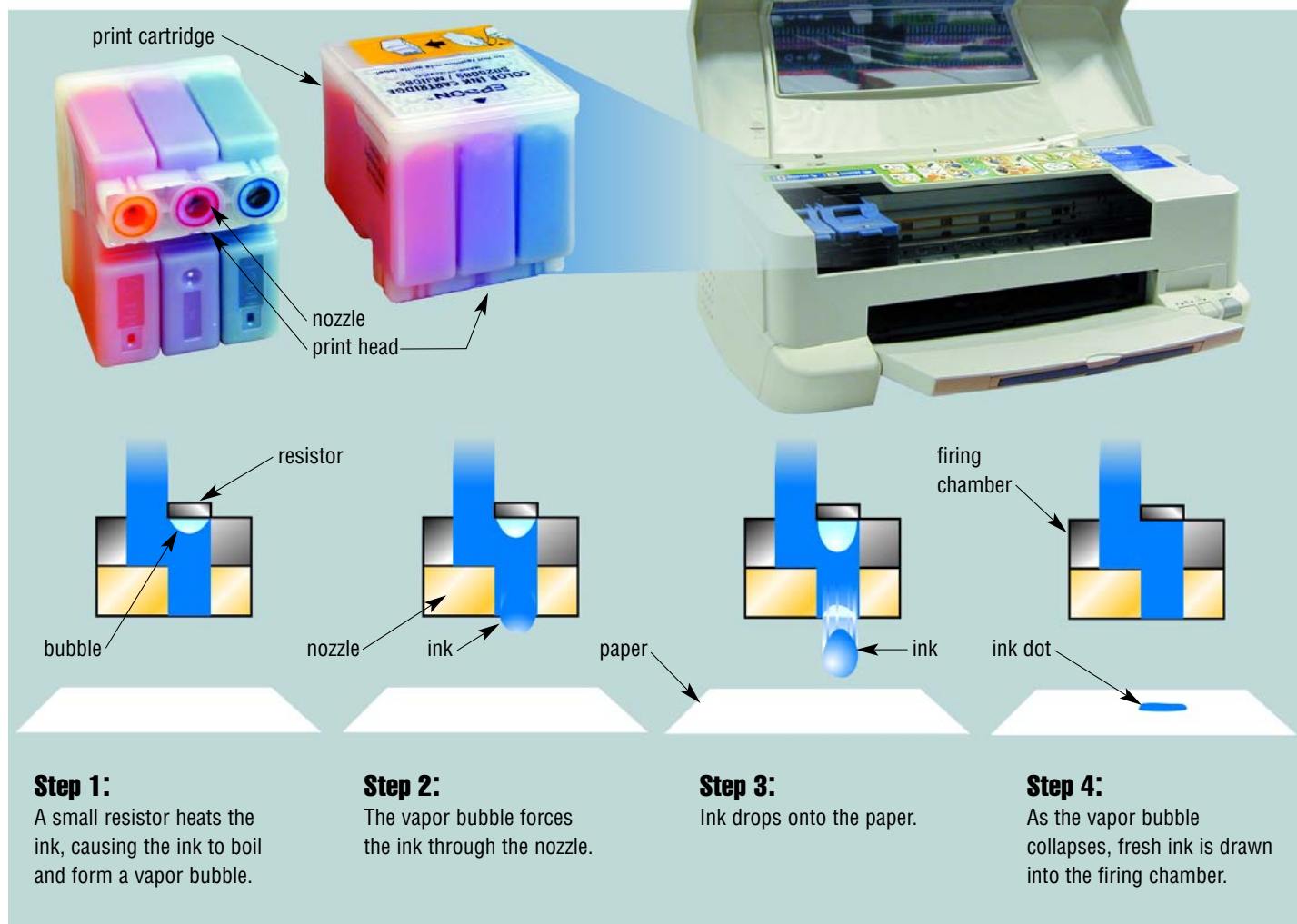




Figure 6-22 Laser printers are used with personal computers, as well as larger computers.

Laser printers can print text and graphics in very high quality resolutions, ranging from 600 to 1,200 dpi. While laser printers typically cost more than ink-jet printers, they also are much faster. A high-end laser printer can print text at speeds of up to 40 pages per minute.

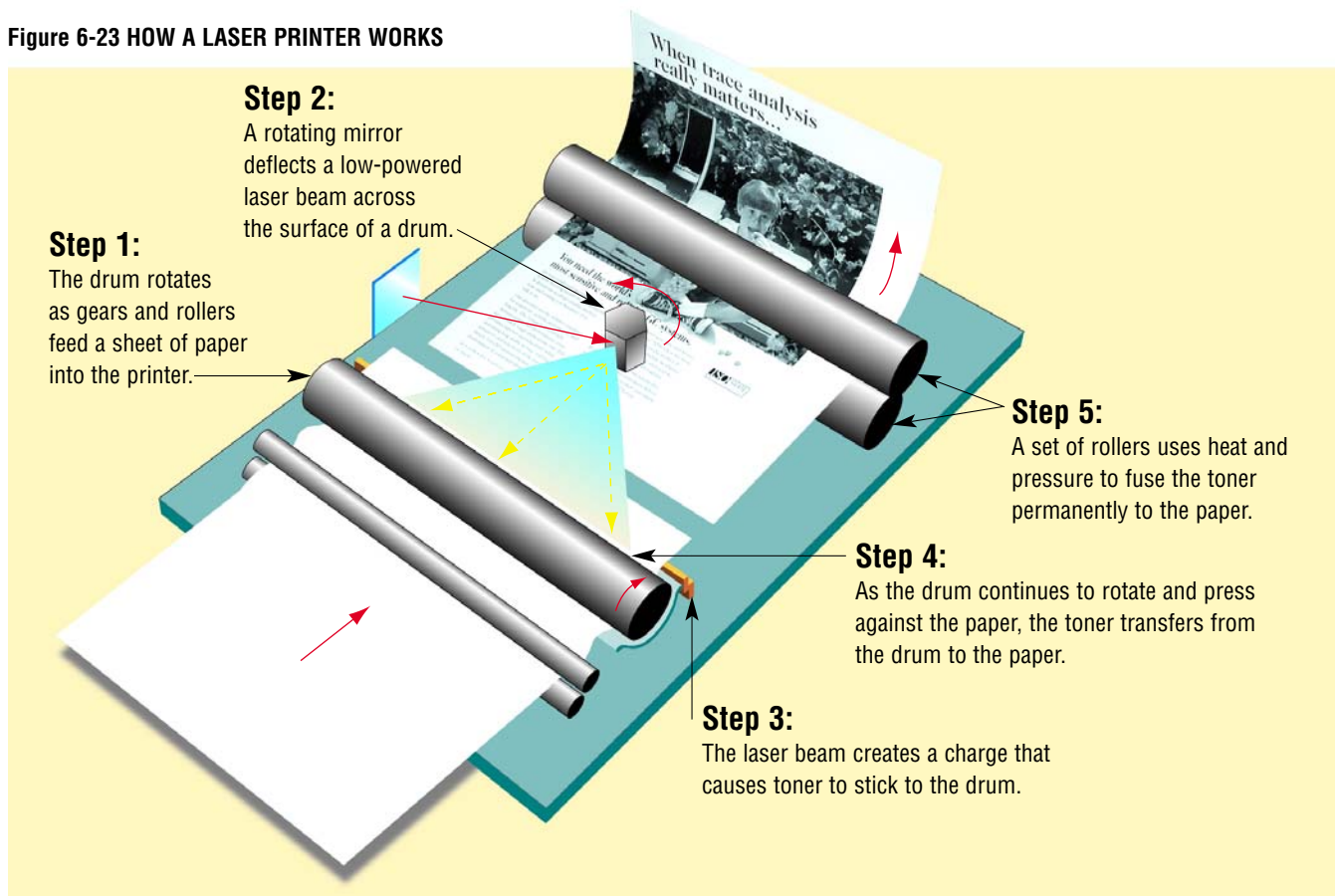
Depending on the quality and speed of the printer, the cost of a black-and-white laser printer ranges from a few hundred to several thousand dollars. The higher the resolution and speed, the more expensive the printer. Mainframe computers use high-end fast laser printers. Although color laser printers are available, they are relatively expensive, with prices often exceeding a thousand dollars.

Operating in a manner similar to a copy machine, a laser printer creates images using a laser beam and powdered ink, called **toner**. The laser beam produces an image on a special drum inside the printer. The light of the laser alters the electrical charge on the drum wherever it hits. When this occurs, the toner sticks to the drum and then transfers to the paper through a combination of pressure and heat (Figure 6-23).

Web Link

For more information on laser printers, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Laser Printers.

Figure 6-23 HOW A LASER PRINTER WORKS





Printers are available in various shapes and sizes and a range of prices. The type of printer you purchase depends on the type of printing you want to do. If the printer is for your business, it either can enhance the professional image you want the world to see — or detract from it. If the printer is for personal use, high-quality output may not be a major factor.

For most people, the choice is between two categories: laser printers and ink-jet printers. A laser printer generally prints at a relatively fast speed and produces high-quality black and white or color output. Resolution continues to improve from the original 300 dots per inch (dpi) to as much as 1,200 dpi. The price per page of a text-oriented document is \$.02 to \$.03. The printer trays for most laser printers can hold as many as 250 sheets of paper, and the printer can handle thousands of pages of output per month. Color laser printers are available and prices have decreased, but they still are expensive.

Although slower, ink-jet printers are less expensive than laser printers. The big advantage is the availability of color printing and entry-level units with low price tags. The price for a page of black-and-white text is around \$.04 per page.

Some factors to consider when purchasing a printer are as follows:

- Primary use
- Space and noise
- Speed or pages per minute (PPM)
- Color capabilities
- Price of consumables
- Print quality and resolution
- Interface – parallel or USB
- Paper handling features

For more information on printers, visit the Discovering Computers 2002 Apply It Web page (scsite.com/dc2002/apply.htm) and click Chapter 6 Apply It #2.

When the toner runs out, you can replace the toner cartridge. Toner cartridge prices range from \$50 to \$100 for about 5,000 printed pages. On average, the cost per printed page on a black-and-white laser printer is \$.02 to \$.03.

When printing a document, laser printers process and store the entire page before they actually print it. For this reason, laser printers sometimes are called page printers. Storing a page before printing requires the laser printer has a certain amount of memory in the device.

Depending on the amount of graphics you intend to print, a laser printer can have up to 200 MB of memory. To print a full-page 600-dpi picture, for instance, you might need 16 MB of memory on the printer. If your printer does not have enough memory to print the picture, it either will print as much of the picture as its memory will allow, or it will display an error message and not print any of the picture. You usually can increase the amount of memory in a laser printer by inserting memory cards into the printer's expansion slots.

Laser printers use software that enables them to interpret a **page description language (PDL)**. A PDL tells the printer how to layout the contents of a printed page. When you purchase a laser printer, it comes with at least one of two common page description languages: PCL or PostScript. Developed by Hewlett-Packard, a leading printer manufacturer, **PCL (Printer Control Language)** is a standard printer language that supports the fonts and layout used in standard office documents. Professionals in the desk-top publishing and graphic art fields commonly use **PostScript** because it is designed for complex documents with intense graphics and colors.

COMPANY ON THE CUTTING EDGE



Coin Toss Determines Output Name

Bill Hewlett and Dave Packard, Stanford University graduates, had invented an audio oscillator while working in their garage, and now they needed a name for their partnership. They decided to use their last names, but whose name should be first? The two friends tossed a coin; Bill Hewlett won.

Walt Disney Studios placed an order in 1939 for eight audio oscillators. Hewlett-Packard (HP) shipped the oscillators to Disney, and the movie studios used the invention to test sound equipment for producing the film *Fantasia*.

Hewlett and Packard created the first set of corporate objectives in 1957, which became known as the HP Way. This philosophy embraces the free exchange of information, trust and respect, integrity, teamwork, and what HP calls Management by Walking Around.

The company's initial products were test and measurement equipment. In the 1960s, their product line expanded to include calculators. HP ushered in the first business minicomputer in 1972. In the 1980s, HP turned toward the microcomputer and printer markets. Today, the manufacturer is noted for a range of high-quality products, including personal computers, notebook computers, scanners, and ink-jet and laser printers.

For more information on Hewlett-Packard, visit the Discovering Computers 2002 Companies Web page (scsite.com/dc2002/companies.htm) and click HP.

Thermal Printers

A **thermal printer** generates images by pushing electrically heated pins against heat-sensitive paper. Basic thermal printers are inexpensive, but the print quality is low and the images tend to fade over time. Thermal printers, however, are ideal for use in small devices such as adding machines.

Two special types of thermal printers have a much higher print quality. A **thermal wax-transfer printer**, also called a **thermal transfer printer**, generates rich, nonsmearing images by using heat to melt colored wax onto heat-sensitive paper. Thermal wax-transfer printers are more expensive than ink-jet printers, but less expensive than many color laser printers. A **dye-sublimation printer**, also called a **thermal dye transfer printer**, uses heat to transfer colored dye to specially coated paper.

Costing several thousand dollars, dye-sublimation printers can create images that are of photographic quality (Figure 6-24). Applications requiring very high image quality, such as medical or security applications, use these printers.

Some manufacturers offer a near dye-sublimation quality printer for the home user that costs several hundred dollars. Most home users, however, purchase a photo printer instead of these inexpensive dye-sublimation quality printers. The next page discusses photo printers.



Figure 6-24 This printer uses dye sublimation technology, which creates photographic quality output.



Counterfeit Money

High-Quality Printers

Short of cash? Some college students found a solution to the problem: they made some. With a scanner, personal computer, and color printer, the students produced bogus bills and passed more than \$1,000 in counterfeit currency before they were caught. As printer quality improves, police have arrested counterfeiters ranging from high school students to senior citizens, and the problem is growing. Spotting fake money is not that difficult, but most people never look that close. If you accept a counterfeit bill, even as change, it is yours. Counterfeiting does not stop with money. Easily available and obtainable are diplomas, degrees, transcripts, Social Security cards, licenses, birth certificates, and Green cards.

Should printer manufacturers take responsibility for this problem? Why or why not? What, if anything, could printer makers do? Should it be illegal for someone to sell these counterfeit documents online? Can you offer any other possible solutions?

For more information on color printers, visit the Discovering Computers 2002 Issues Web page (scsite.com/dc2002/issues.htm) and click Chapter 6 Issue #3.

Web Link

For more information on photo printers, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Photo Printers.

Photo Printers

A **photo printer** is a color printer that can produce photo lab quality pictures as well as printing everyday documents. In addition, many photo printers can read media directly from a digital camera (Figure 6-25). That is, you do not need to attach the printer to your computer. Simply remove the storage device, such as a media card, from the digital camera and insert it into the printer.

Then, push buttons on the printer to select the desired photo, specify the number of copies, and indicate the size of the printed image. Size options for printed photographs can range from 3 x 3 inches to 13 x 19 inches. Some even print panoramic photographs.

Many photo printers use ink-jet technology. Thus, you can connect a photo printer to your computer and use it for all your printing needs. For a few hundred dollars, this printer is ideal for the home or small business user.

Figure 6-25 HOW SOME PHOTO PRINTERS WORK WITH A DIGITAL CAMERA



Label and Postage Printers

A **label printer** is a small printer that prints on an adhesive-type material that can be placed on a variety of items such as envelopes, packages, floppy disks, CDs, DVDs,

audiocassettes, photographs, file folders, and toys. Most label printers also print bar codes.

Some newer model label printers have built-in digital scales and can print e-stamps (Figure 6-26). An **e-stamp**, also called **Internet**

postage, is digital postage you buy and print right from your personal computer. That is, you purchase an amount of postage from an authorized postal service Web site and download it directly to the label printer. As you need stamps, you print them on the label printer.



Figure 6-26 Many label printers have built-in digital scales and can print e-stamps.

ISSUE

Print Your Own Photographs

Digital Cameras and Photo Printers

As with any technology, the price of digital cameras and photo printers continues to decrease. Lower prices are an enticement for more and more people to turn away from traditional cameras and film developing to digital photography. Digital cameras radically have simplified the process of getting your pictures into your personal computer. Even so, all cameras live or die on image quality. Some experts suggest that the 35mm still is king and the traditional camera rules, especially when making photographs for glossy reports or other high-quality publications. How much quality is lost by using a digital camera? Maybe none. Other experts argue that a digital camera produces better quality than a film camera in many important respects and praise the digital camera as the answer to all photographic needs.

So whom can you believe? Does this mean one should throw away the 35mm camera? Is this the end of the traditional camera? What is your opinion of the digital camera? How much longer before the demise of purchasing rolls of films and print development? Alternatively, will traditional cameras continue for many more years?

For more information on digital cameras and photo printers, visit the Discovering Computers 2002 Issues Web page (scs.site.com/dc2002/issues.htm) and click Chapter 6 Issue #4.

TECHNOLOGY TRAILBLAZER

CARLY FIORINA

It seems somewhat improbable that a shipping department secretary would someday return to become the company's chairman of the board, but it is a true story for Carly Fiorina. As Hewlett-Packard's leader, she is focusing on improving profitability, innovation, customer service, and Internet applications.

Fiorina credits her liberal arts undergraduate studies at Stanford University, with majors in philosophy and medieval history, with helping her learn how to think and make choices. She urges college graduates to love what they do, not to make choices to please someone else.

After a brief stint in law school, she became a sales representative for AT&T. That short-term job eventually grew into leading and guiding Lucent Technologies, Inc., the AT&T spin-off, to one of the most successful IPO stock offerings. Fiorina says leadership involves influencing others and mastering change. It also empowers people to reach their full potential and make decisions.

For more information on Carly Fiorina, visit the Discovering Computers 2002 People Web page (scs.site.com/dc2002/people.htm) and click Carly Fiorina.



Portable Printers

A **portable printer** is a small, lightweight printer that allows a mobile user to print from a notebook or handheld computer while traveling (Figure 6-27). Barely wider than the paper on which they print, portable printers easily can fit in a briefcase alongside a notebook computer.

Some portable printers use ink-jet technology. Others are thermal or thermal wax-transfer. Many of these printers connect to a parallel port or USB port. Others have a built-in wireless infrared port through which they communicate with the computer.



Figure 6-27 A portable printer is a small, compact printer that allows the mobile user to print from a notebook or handheld computer while traveling.

Plotters and Large-Format Printers

Plotters are sophisticated printers used to produce high-quality drawings such as blueprints, maps, and circuit diagrams. These printers are used in specialized fields such as engineering and drafting, and usually are very costly. Current plotters use a row of charged wires (called styli) to draw an electrostatic pattern on specially coated paper and then fuse toner to the pattern. The printed image consists of a series of very small dots, which provide high-quality output.

Operating like an ink-jet printer, but on a much larger scale, a **large-format printer** creates photo-realistic quality color prints. Used by graphic artists, these high costing, high performance printers are used for signs, posters, and other displays (Figure 6-28).

Plotters and large-format printers typically can handle paper with widths up to 60 inches because blueprints, maps, signs, posters and other such drawings and displays can be quite large. Some plotters and large-format printers use individual sheets of paper, while others take large rolls.



Figure 6-28 Graphic artists use large-format printers to print signs, posters, and other displays.

SPEAKERS AND HEADSETS

An **audio output device** is a component of a computer that produces music, speech, or other sounds, such as beeps. Two commonly used audio output devices are speakers and headsets.

Most personal computers have a small internal speaker that usually outputs only low-quality sound. For this reason, many personal computer users add sophisticated stereo **speakers** to their computers to generate a higher-quality sound (Figure 6-29). Some monitors even have larger speakers built into the sides of the monitor.

To boost the low bass sounds, some users add a **woofer** (also called a subwoofer). You connect the stereo speakers and woofer to ports on the sound card. Most speakers have tone and volume controls so you can adjust settings.

When using speakers, anyone within listening distance can hear the output. If you are in a computer laboratory or some other crowded environment, speakers might not be practical. Instead, you can plug a headset into a port on the sound card. With the **headset**, only you can hear the sound from the computer (Figure 6-30).



Figure 6-29 Many personal computer users have high-quality stereo speakers and a woofer for their computers.



Figure 6-30 In a crowded environment where speakers are not practical, you can use a headset for audio output.



Before purchasing a new computer or upgrading an existing one, you should consider the ways in which you will use it. Unless sound plays a minor role in your life, you will want to consider a stand-alone sound card. Most inexpensive computers integrate a sound chip with the motherboard. Look at the back of the computer. If the microphone and speaker ports are grouped together with the keyboard/mouse connector and the serial port, you have an integrated onboard sound chip.

Until recently, Creative Lab's Sound Blaster (see URL below) card has dominated the computer sound market. If a sound card were not Sound Blaster compatible, it would not sell. This is because most games require a Sound Blaster compatible sound card. Even though new technology opened the door for other options, Sound Blaster is still the de facto standard. Today's cards make games and multimedia applications sound great and provide users with the capability to compose, edit, and print their own music; learn to play the piano; record and edit digital audio; and play audio CDs.

The biggest change in sound card architecture was the introduction of 3D-positional audio. Primarily used with games, the 3D-positional audio algorithm fools your brain into thinking sounds are emanating from somewhere other than the speakers sitting in front of you.

Purchasing a sound card is an individual decision. To get a better idea of what you should purchase to fit your budget and lifestyle, consider the following:

1. How much money do you plan to spend?
2. Will you use the sound card for playing games or music, recording digital audio?
3. Select two or three cards and then read online reviews (see URL below).

For more information on computer sound systems and the Web sites mentioned above, visit the Discovering Computers 2002 Apply It Web page (scs.site.com/dc2002/apply.htm) and click Chapter 6 Apply It #3.

Electronically produced voice output is growing in popularity. **Voice output** occurs when you hear a person's voice or when the computer talks to you through the speakers on the computer. As discussed in Chapter 2, you can listen to interviews, talk shows, sporting events, news, recorded music, and live concerts from many radio and television stations on the Web. Some Web sites dedicate themselves to providing voice output, where you can hear songs, quotes, and historical speeches and lectures (Figure 6-31).

Very often, voice output works with voice input. **Internet telephony**, for example, allows you to have a conversation over the Web, just as if you were on the telephone.

Sophisticated programs enable the computer to converse with you. Talk into the microphone and say, "I'd like today's weather report." The computer replies, "For which city?" You reply, "Chicago." The computer says, "Sunny and 80 degrees."

OTHER OUTPUT DEVICES

Although monitors, printers, and speakers are the more widely used output devices, many other output devices are available for particular uses and applications. These include data projectors, facsimiles, and multifunction devices. The following pages discuss each of these devices.

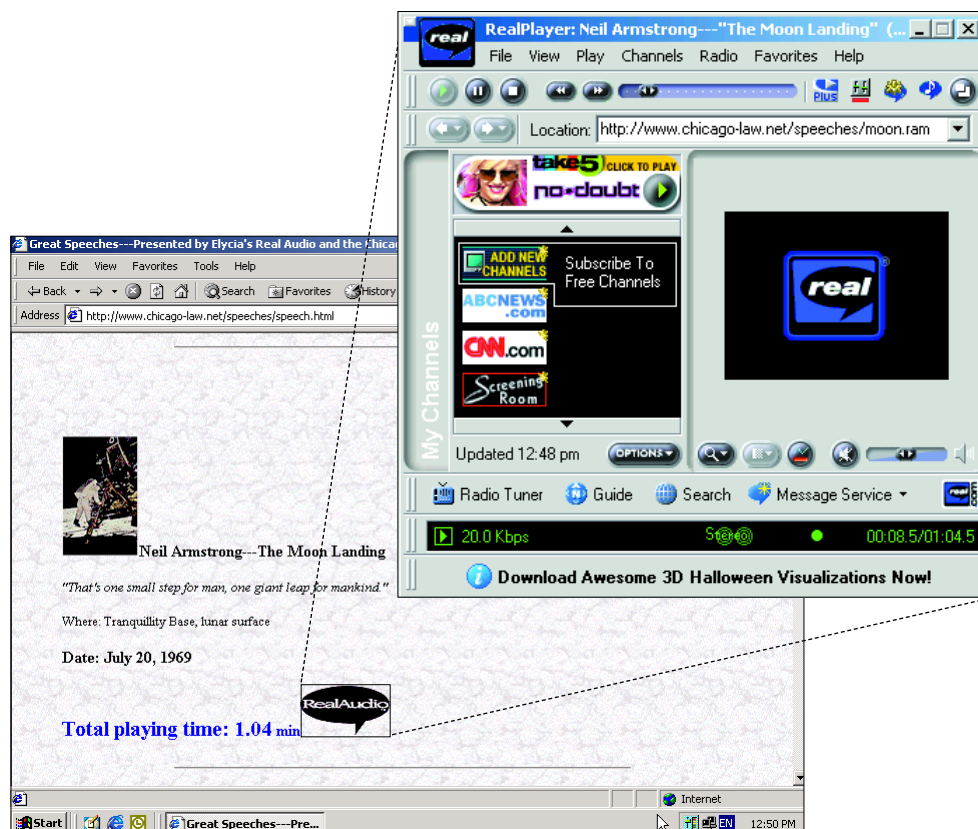


Figure 6-31 You can listen to historical speeches and lectures from the Web. Playing here is an audio broadcast made by Neil Armstrong as he walked on the moon for the first time.

Data Projectors

A **data projector** is a device that takes the image from a computer screen and projects it onto a larger screen so an audience of people can see the image clearly. For example, many classrooms use data projectors so all students easily can see an instructor's presentation on the screen (Figure 6-32).

Some data projectors are large devices that attach to a ceiling or wall in an auditorium. Others are small portable devices. Two types of smaller, lower-cost units are LCD projectors and DLP projectors.

An **LCD projector**, which uses liquid crystal display technology, attaches directly to a computer and uses its own light source to display the information shown on the computer screen. Because LCD projectors tend to produce lower-quality images, some users prefer to use a DLP projector for sharper, brighter images.

A **digital light processing (DLP) projector** uses tiny mirrors to reflect light, which produces crisp, bright, colorful images that remain in focus and can be seen clearly even in a well-lit room.

Facsimile (Fax) Machine

A **facsimile (fax) machine** is a device that transmits and receives documents over telephone lines. The documents can contain text, drawings, or photographs, or can be handwritten. The term fax also refers to a document that you send or receive via a fax machine.

A stand-alone fax machine scans an original document, converts the image into digitized data, and transmits the digitized image (Figure 6-33). A fax machine at the receiving end reads the incoming data, converts the digitized data into an image, and prints or stores a copy of the original image.



Figure 6-33 A stand-alone fax machine.



Figure 6-32 DLP projectors produce sharp, bright images.



Many computers include fax capability by using a fax modem.

A **fax modem** is a modem that also allows you to send (and sometimes receive) electronic documents as faxes (Figure 6-34). A fax modem transmits computer-prepared documents, such as a word processing letter, or documents that have been digitized with a scanner or digital camera. A fax modem transmits these faxes to a fax machine or to another fax modem.

When a computer (instead of a fax machine) receives a fax, you can view the fax on the screen, saving the time and expense of printing it. If you wish, you also can print the fax using special fax software. The quality of the viewed or printed fax is less than that of a word processing document because the fax actually is a large image. Optical character recognition (OCR) software enables you to convert the image to text and then edit it.

Web Link

For more information on fax modems, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Fax Modems.

A fax modem can be an external device that plugs into a port on the back of the system unit or an internal card you insert into an expansion slot on the motherboard.

Multifunction Devices

A **multifunction device (MFD)** is a single piece of equipment that looks like a copy machine, but

provides the functionality of a printer, scanner, copy machine, and perhaps a fax machine (Figure 6-35). The features of these devices, which are sometimes called multifunction peripherals (MFPs) or all-in-one devices, vary widely. For example, some use color ink-jet printer technology, while others include a black-and-white laser printer.



Figure 6-35 This multifunction device is a color printer, scanner, copy machine, and fax machine all in one.

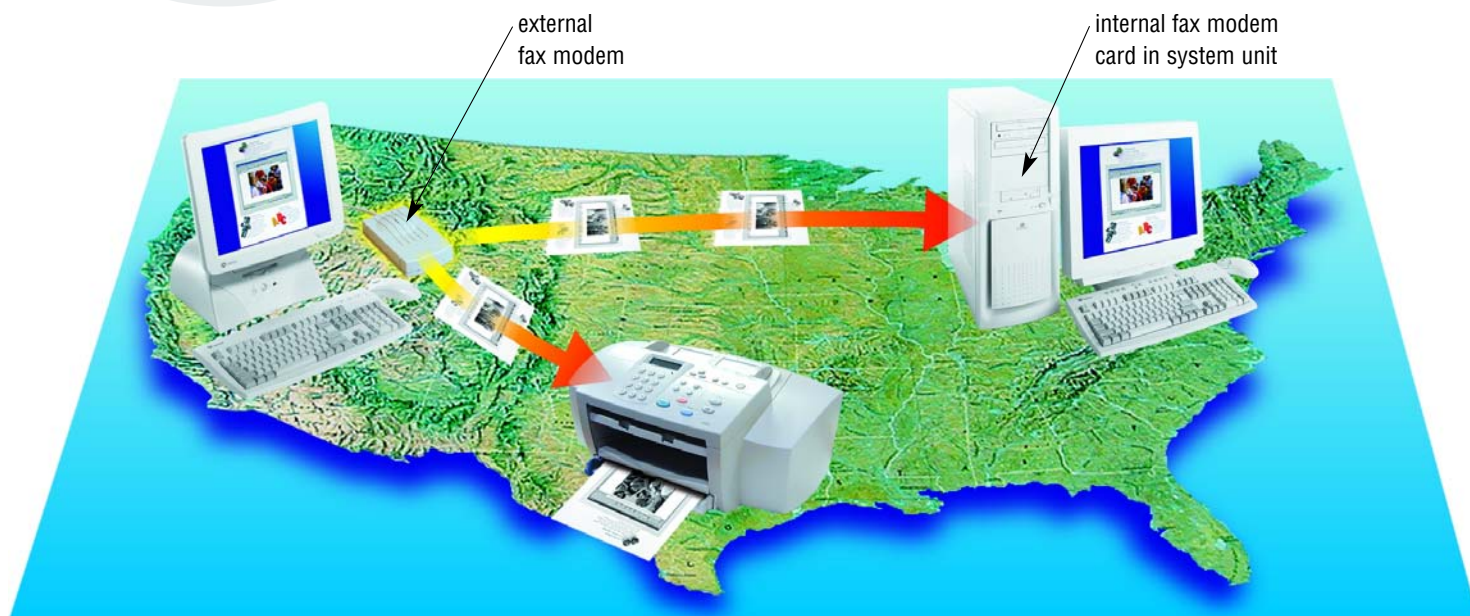


Figure 6-34 A fax modem allows you to send (and sometimes receive) electronic documents as faxes to a fax machine or another computer.

Small offices and home offices (SOHOs) use MFDs because they require less space than having a separate printer, scanner, copy machine, and fax machine. Another advantage of an MFD is that it is significantly less expensive than if you purchase each device separately. If the device breaks down, however, you lose all four functions, which is the primary disadvantage. Given all the advantages, more users are bringing MFDs into their offices and homes.

TERMINALS

A **terminal** is a device that performs both input and output because it consists of a monitor (output), a keyboard (input), and a video card. Terminals fall into three basic categories: dumb terminals, intelligent terminals, and special-purpose terminals.

A **dumb terminal** has no processing power; thus, cannot function as an independent device (Figure 6-36). A dumb terminal can enter and transmit data to, or receive and display information from, a computer to which it is connected. Dumb terminals connect to a **host computer** that performs the processing and then sends the output back to the dumb terminal. The host computer usually is a mid-range server, mainframe, or supercomputer.

Web Link

For more information on multifunction devices, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Multifunction Devices.



Jack of all Trades

Multifunction Devices

Designing and setting up a home office is a challenge. In addition to a computer, other required hardware most likely includes a printer, fax machine, copy machine, and scanner. When selecting these components, you have several options to consider. One option is to purchase each of these as a separate device. A second option is to purchase a combination printer and scanner or combination printer and fax machine. A third option is to purchase a multifunction device that contains all four of these hardware devices. Generally, a multifunction device represents a convenient and efficient way to expand the type of document input and output facilities. On the other hand, performance offered by multifunction devices rarely matches individual devices that are designed specifically for the job. Which option would be best? How would budget and workspace affect your choice? Why? What advantages or disadvantages are there in relation to connecting these devices to a personal computer?

For more information on multifunction devices, visit the Discovering Computers 2002 Issues Web page (scsite.com/dc2002/issues.htm) and click Chapter 6 Issue #5.



Figure 6-36 Dumb terminals have no processing power and usually are connected to larger computer systems.

In addition to a monitor and keyboard, an **intelligent terminal** also has memory and a processor that has the capability of performing some functions independent of the host computer. Intelligent terminals sometimes are called **programmable terminals** because they can be programmed by the software developer to perform basic tasks. In recent years, personal computers have replaced most intelligent terminals.

Other special-purpose terminals perform specific tasks and contain features uniquely designed for use in a particular industry. Two of these special-purpose terminals are point-of-sale terminals and automated teller machines (Figure 6-37).

A **point-of-sale (POS)** terminal records purchases at the point where the consumer purchases a product or service. The POS terminal used in a grocery store, for example, is a combination of an electronic cash register and bar code reader. As described in Chapter 5, grocery store UPC bar codes contain data that identify the manufacturer and item of a product. When the check out clerk scans the bar code on the food product (input), the computer uses the manufacturer and item numbers to look up the price of the item and the complete product name in the database. Then, the price of the item from the database displays on the monitor (output), the name of

the item and its price print on a receipt (output), and the item being sold is recorded so the inventory can be updated. Thus, the output from POS terminals serves as input to other computers to maintain sales records, update inventory, verify credit, and perform other activities associated with the sales transactions that are critical to running the business.

Many POS terminals handle credit card or debit card payments. Simply swipe your card through the reader (input) and the system processes your credit or debit card. Once approved, the terminal usually prints a receipt for a customer (output).



Figure 6-37 Point-of-sale terminals record purchases at the moment the consumer purchases a product or service. Automated teller machines are self-service banking machines that connect to a host computer through a telephone network.

An **automated teller machine (ATM)** is a self-service banking machine that connects to a host computer through a telephone network. You insert a plastic bankcard with a magnetic strip into the ATM and enter your password, called a personal identification number (PIN), to access your bank account. Some ATMs have touch screens, while others have special keyboards for input. Using an ATM, you can withdraw cash, deposit money, transfer funds, or inquire about an account balance. When your transaction is complete, the ATM prints a receipt for your records.

OUTPUT DEVICES FOR PHYSICALLY CHALLENGED USERS

As discussed in Chapter 5, the growing presence of computers in people's lives has generated an awareness of the need to address computing requirements for those with physical limitations. For users with mobility, hearing, or vision disabilities, many different types of output devices are available. Hearing-impaired users, for example, can instruct programs to display words instead of sounds. With the Windows operating system, these users also can set options to make programs easier to use. For example, the Magnifier command enlarges text and other items in a window on the screen (Figure 6-38).

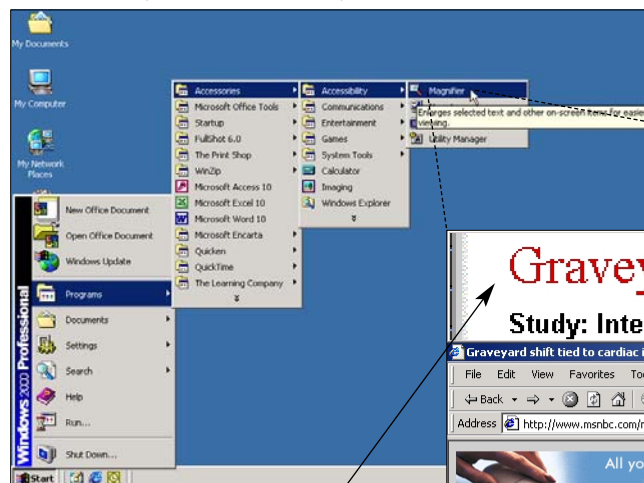
Web Link

For more information on POS terminals visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click POS Terminals.

Web Link

For more information on automated teller machines, visit the Discovering Computers 2002 Chapter 6 WEB LINK page (scsite.com/dc2002/ch6/weblink.htm) and click Automated Teller Machines.

Figure 6-38a (Magnifier command)



location of mouse pointer magnified at top of screen

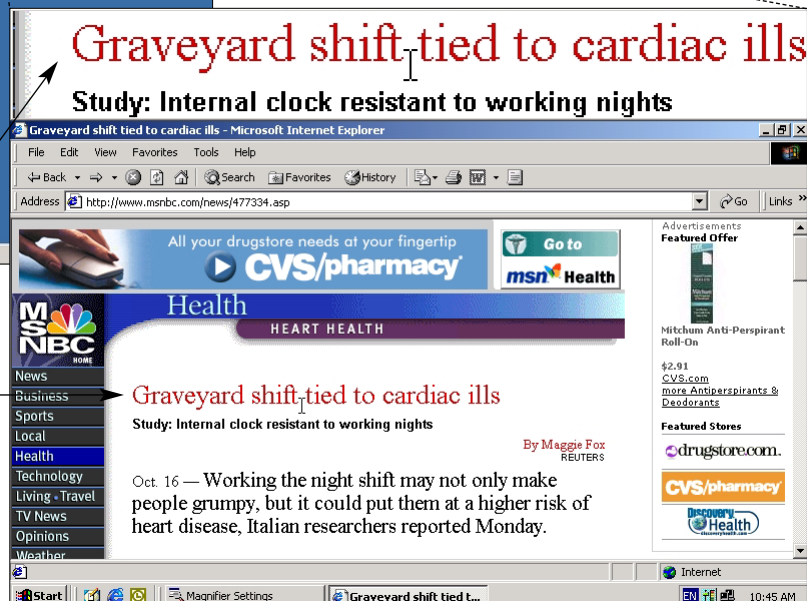


Figure 6-38b (screen with magnification window at top)

Figure 6-38 The Magnifier command in Windows enlarges text and other on-screen items for individuals with vision disabilities.

Visually impaired users can change Windows settings such as increasing the size or changing the color of the text to make the words easier to read. Instead of using a monitor, blind users can work with

voice output. That is, the computer reads the information that displays on the screen. Another alternative is a **Braille printer**, which outputs information in Braille onto paper (Figure 6-39).



Figure 6-39
A Braille printer.

TECHNOLOGY TRAILBLAZER

HEIDI VAN ARNEM

The needs of the disability community often go unmet, but Heidi Van Arnem is helping to enhance the lives of people with disabilities and the individuals and organizations that support them. As chairman and CEO of iCan.com, she helps to bring together businesses, the medical industry, government-led efforts, and nonprofits.

As a successful businesswoman, entrepreneur, and inventor, Van Arnem is recognized as one of the Top 25 Women on the Web. She was the first recipient of the Evan Kemp Entrepreneur of the Year award by the President's Committee on Employment of People with Disabilities and has received numerous awards for her business achievements and community outreach by organizations such as the U.S. Chamber of Commerce. In addition, Van Arnem's Spend a Day in a Wheelchair program has received national acclaim for helping sensitize students to the difficulties wheelchair users face.

A quadriplegic since 16 from a gunshot wound to the neck, Van Arnem established the Heidi Van Arnem foundation in 1992. This nonprofit organization is dedicated to helping find a cure for paralysis.

For more information on Heidi Van Arnem, visit the Discovering Computers 2002 People Web page (scsite.com/dc2002/people.htm) and click Heidi Van Arnem.



SUGGESTED OUTPUT DEVICES BY USER

USER	MONITOR
	• 17- or 19-inch color CRT monitor • High-definition television
	• 19- or 21-inch color CRT monitor • Color LCD display for handheld computer
	• 15.4-inch color LCD display with a notebook computer • 19-inch color CRT monitor for a notebook computer docking station • Color LCD display for handheld computer
	• 19- or 21-inch color CRT or LCD monitor • 15.4-inch color LCD display for a notebook computer • Color LCD display for handheld computer
	• 21-inch color LCD monitor

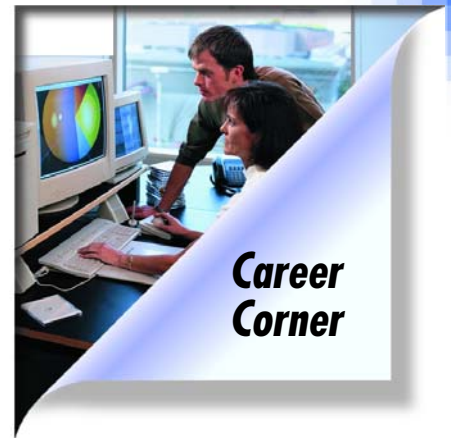
Figure 6-40 This table recommends suggested output devices for various types of users.

PUTTING IT ALL TOGETHER

Many factors influence the type of output devices you should use: the type of output desired, the hardware and software in use, and the desired cost. Figure 6-40 outlines several suggested monitors, printers, and other output devices for various types of computer users.

CHAPTER SUMMARY

Data is a collection of raw, unprocessed facts, figures, and symbols. Computers process and organize data into information, which has meaning and is useful. This chapter described the various methods of output and several commonly used output devices. Output devices presented included display devices, printers, speakers, data projectors, fax machines, multifunction devices, and terminals.

**Graphics Designer/Illustrator**

A designer or illustrator is an artist, but generally does not create original works. Instead, their job is to portray visually the ideas of their clients. Illustrators work in fields such as fashion, technical, medical, animation, or even that of a cartoonist. Designers create visual impressions of products and advertisements. Some of these are as follows:

- Graphic designers – design book covers, stationery, CD covers, and CD embossments
- Costume and theater designers – design costumes and settings for theater and television
- Interior designers – design the layout, decor, and furnishings of homes and buildings
- Jewelry designers – design jewelry, including some one of a kind
- Fashion designers – design clothing, shoes, and other fashion accessories

Education-wise, you can find certificate, two-year, four-year, and master level programs within the design area. Many individuals choose to freelance, while others work with ad agencies, publishing companies, design studios, or specialized departments within large companies. Salaries may range anywhere from \$25,000 to \$75,000 plus, based on experience and educational background.

Adobe (see URL below) offers a Certified Expert Program. To become an Adobe® Certified Expert, you must pass an Adobe Product Proficiency Exam for the product for which you want to be certified.

To learn more about graphics design and illustration as a career and the Web site mentioned above, visit the Discovering Computers 2002 Careers Web page (scs.site.com/dc2002/careers.htm) and click Graphics Designer/Illustrator.

PRINTER	OTHER
• Ink-jet color printer; <i>or</i> • Photo printer • Label printer	• Speakers • Headset
• Multifunction device; <i>or</i> • Ink-jet color printer; <i>or</i> • Laser printer, black and white • Label printer	• Fax machine • Speakers
• Portable printer • Ink-jet color printer; <i>or</i> • Laser printer, black and white, for in-office use; <i>or</i> • Photo printer	• Fax modem • Headset • DLP data projector
• Laser printer, black and white • Line printer (for large reports from a mainframe) • Label printer	• Fax machine <i>or</i> fax modem • Speakers • DLP data projector • Dumb terminal
• Laser printer, black and white • Plotter • Photo printer; <i>or</i> • Dye sublimation printer	• Fax machine <i>or</i> fax modem • Speakers • Headset

E-GOVERNMENT

STAMP OF APPROVAL

Making a Federal Case for Useful Information

When it is time to buy stamps to mail your correspondence, you no longer need to wait in long lines at your local post office. Instead, log on to the Internet and download a stamp right to your personal computer.

The U.S. Postal Service has authorized several corporations to sell stamps online. Users can download software from a company's Web site, charge the postage fee to a credit card, and then print the postage on a label printer or directly onto envelopes and labels. Some of these Web sites, such as Stamps.com, shown in Figure 6-41, charge a small percentage of each order as a convenience fee.

Although citizens may not be enthusiastic about paying income taxes, April 15 can be more tolerable knowing that some of their hard-earned dollars are spent subsidizing useful government Web sites.

You can recognize these Web sites on the Internet by their .gov top-level domain abbreviation. For example, the Library of Congress Web site is lcweb.loc.gov. As the oldest federal cultural institution in the United States and the largest library in the world, the mission of the Library of Congress is to serve the research needs of the U.S. Congress. Patrons can visit one of 22 reading rooms on Capitol Hill and access more than 115 million items written in 450 languages. The Library of Congress Web site, shown in Figure 6-42, has forms and information from the Copyright Office, an

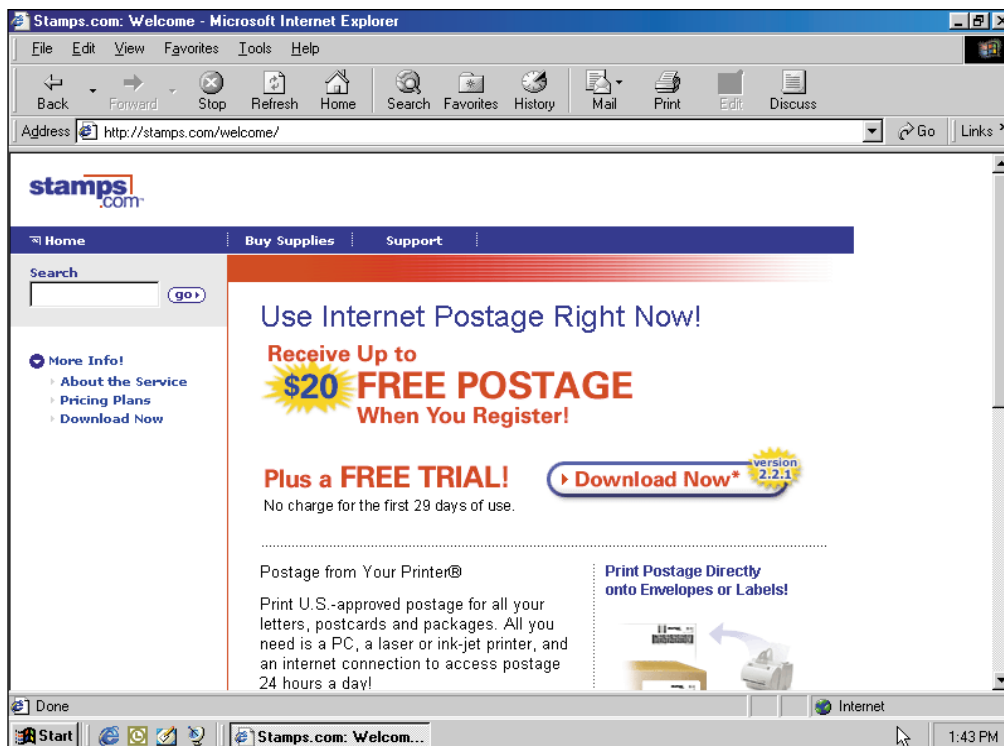


Figure 6-41 Purchasing stamps on the Internet eliminates making a trip to the post office and waiting in long lines.

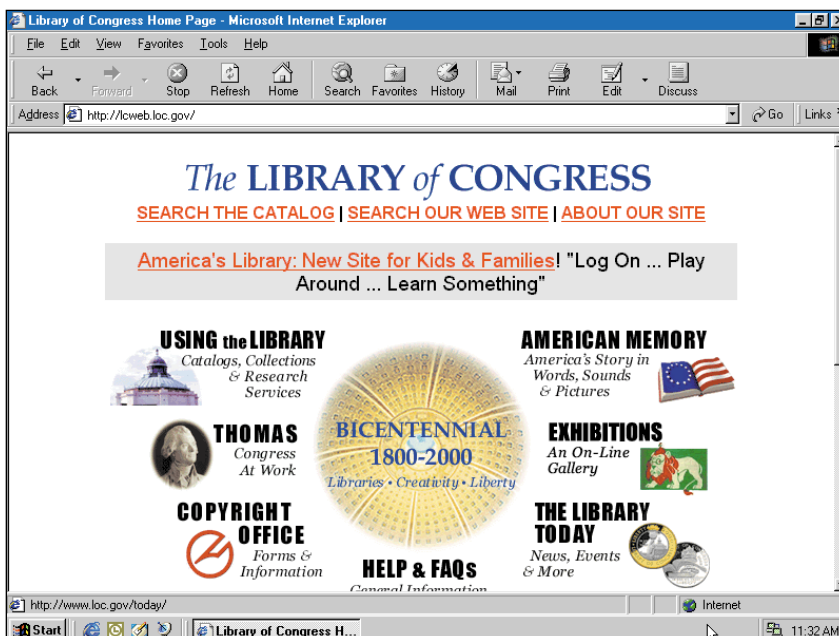


Figure 6-42 The Library of Congress Web site contains more than 115 million items written in 450 languages.

online gallery, and links to a variety of topics, including the National Agricultural Library and the National Library of Medicine. These and other government resources Web sites are listed in Figure 6-43.

Government and military Web sites offer a wide range of information. The Time Service Department Web site will provide you with the correct time. If you are looking for a federal document, the FedWorld Information Network lists thousands of documents distributed by the government on its Web site. For access to the names of your congressional representatives, the president's cabinet members, and the Supreme Court justices; or to read portions of a federal statute or the U.S. Constitution, visit the extensive Hieros Gamos Web site, which is a governmental and legal portal with links to the legislative, judicial, and executive branches of government.

For more information on government resources Web sites, visit the Discovering Computers 2002 E-Revolution Web page (scsite.com/dc2002/e-rev.htm) and click Government.

GOVERNMENT RESOURCES WEB SITES	URL
Postage	
Pitney Bowes	pitneybowes.com
Simply Postage	simplypostage.com
Stamps.com	stamps.com
Government	
FedWorld Information Network	fedworld.gov
Hieros Gamos	hg.org
Library of Congress	lcweb.loc.gov
National Archives and Records Administration	www.nara.gov
National Agricultural Library	www.nal.usda.gov
National Library of Medicine	www.nlm.nih.gov
The White House	www.whitehouse.gov
Thomas Legislative Information	thomas.loc.gov
Time Service Department	tycho.usno.navy.mil
U.S. Department of Education	ed.gov
U.S. Government Printing Office	www.access.gpo.gov
U.S. Patent and Trademark Office	www.uspto.gov
U.S. Treasury	treas.gov
USA Jobs	www.usajobs.opm.gov
<i>For an updated list of government resources Web sites, visit scsite.com/dc2002/e-rev.htm.</i>	

Figure 6-43 These Web sites offer information on buying U.S.-approved postage online and researching federal agencies.



E-GOVERNMENT

applied:

1. View the three postage Web sites listed in Figure 6-43. Compare and contrast the available services on each one. Consider postage cost, necessary equipment, shipping services, security techniques, and tracking capability. Explain why you would or would not like to use this service.
2. Visit the Hieros Gamos Web site listed in Figure 6-43. What are the names, addresses, and telephone numbers of your two state senators and your local congressional representative? On what committees do they serve? Who is the chief justice of the Supreme Court, and what has been this justice's opinion on two recently decided cases? Who are the members of the president's cabinet? Then, visit two other Web sites listed in Figure 6-43. Write a paragraph on each Web site describing its content and features.

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 **Web Instructions:** To display this page from the Web, start your browser and enter the URL scs.site.com/dc2002/ch6/summary.htm. Click the links for current and additional information. To listen to an audio version of this In Summary, click the Audio button. To play the audio, RealPlayer must be installed on your computer (download by clicking [here](#)).

1

What Are the Four Types of Output?

Output is data that has been processed into a useful form, called information. Four types of output are text, graphics, audio, and video. **Text** consists of characters used to create words, sentences, and paragraphs. A **graphic** or **graphical image** is a digital representation of nontext information such as a drawing, chart, or photograph. **Audio** is music, speech, or any other sound. **Video** consists of full-motion images that are played back at various speeds.

2

What Are the Different Types of Output Devices?

An **output device** is any hardware component capable of conveying information to a user. A **display device** is an output device that visually conveys text, graphics, and video information. A **printer** is an output device that produces text and graphics on a physical medium such as paper or transparency film. An **audio output device** produces music, speech, or other sounds. Other output devices include data projectors, facsimile (fax) machines, and multifunction devices.

3

What Factors Affect the Quality of a Monitor?

A **monitor** is a display device that consists of a screen housed in a plastic or metal case. The quality of the display depends on a monitor's resolution, dot pitch, and refresh rate. **Resolution**, or sharpness, is related to the number of pixels a monitor can display. **Dot pitch**, a measure of image clarity, is the distance between each pixel. **Refresh rate** is the speed with which a monitor redraws images on the screen. Refresh rate should be fast enough to maintain a constant, flicker-free image. A **video card** converts digital output into an analog video signal that is sent through a cable to the monitor. How the picture is produced is determined by the display device. Several standards define resolution, the number of colors, and other monitor

properties. Today, most monitors and video cards support the **super video graphics array (SVGA)** standard.

4

What Are Monitor Ergonomic Issues?

Features that address monitor ergonomic issues include controls to adjust the brightness, contrast, positioning, height, and width of images. Many monitors have a tilt-and-swivel base so the angle of the screen can be altered to minimize neck strain and glare. CRT monitors produce a small amount of **electromagnetic radiation (EMR)**, which is a magnetic field that travels at the speed of light. High-quality CRT monitors should comply with [MPR II standards](#), which define acceptable levels of EMR for a monitor.

5

How Are Various Types of Printers Different?

Printers produce printed information, called **hard copy**. Generally printers are grouped into two categories: impact and nonimpact. An **impact printer** forms characters and graphics by striking a mechanism against an ink ribbon that physically contacts the paper. A **dot-matrix printer** is an impact printer that prints images when tiny wire pins on a print head mechanism strike an inked ribbon. A **line printer** is a high-speed impact printer that prints an entire line at one time. A **nonimpact printer** creates characters and graphics without actually striking the paper. An **ink-jet printer** is a high-speed, high-quality nonimpact printer that sprays drops of ink onto a piece of paper. A **laser printer** is a nonimpact printer that operates in a manner similar to a copy machine. A **thermal printer** generates images by pushing electrically heated pins against heat-sensitive paper. A printer capable of [Internet printing](#) receives print instructions from an Internet service, allowing it to print documents from desktop and wireless devices. Other types of printers include **photo printers**, **label printers**, **portable printers**, and **plotters**.

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6

What Are Various Types of Audio Output Devices?

Two commonly used audio output devices are **speakers** and **headsets**. Most personal computers have an internal speaker that outputs low-quality sound. Many users add high-quality stereo speakers or purchase personal computers with larger speakers built into the sides of the monitor. A **woofer** can be added to boost low bass sounds. A headset plugged into a port on the sound card allows only the user to hear sound from the computer.

7

Why Are Data Projectors, Fax Machines, and Multifunction Devices Used?

A **data projector** takes the image on a computer screen and projects it onto a large screen so an audience of people can see the image. A **facsimile (fax) machine** transmits and receives documents over telephone lines. A **fax modem** is a communications device that sends (and sometimes receives) electronic documents as faxes. A **multifunction device (MFD)** is a single piece of equipment that looks like a copy machine, but provides the functionality of a printer, scanner, copy machine, and sometimes a fax machine.

8

How Is a Terminal Both an Input and Output Device?

A **terminal** is a device that consists of a keyboard (input), a monitor (output), and a video card. A terminal is used to input and transmit data to, or receive and output information from, a **host computer** that performs the processing. Three basic categories of terminals are **dumb terminals**, **intelligent terminals**, and **point-of-sale (POS)** terminals.

9

What Are Output Options for Physically Challenged Users?

For users with mobility, hearing, or vision disabilities, many different types of output devices are available. Hearing-impaired users can instruct programs to display words instead of produce sounds. Visually impaired users can change the size or color of text to make words easier to read. Blind users can utilize voice output, where the computer reads information that displays on the screen. A **Braille printer** outputs information in Braille onto paper.

Key Terms

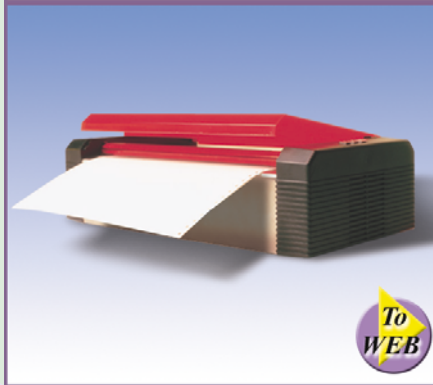
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Web Instructions: To display this page from the Web, start your browser and enter the URL scsite.com/dc2002/ch6/terms.htm. Scroll through the list of terms. Click a term to display its definition and a picture. Click the To WEB button for current and additional information about the term from the Web. To see animations, Shockwave and Flash Player must be installed on your computer (download by clicking [here](#)).

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BRaille PRINTER

Printer for blind users that outputs information in Braille onto paper. (6.30)



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video card (6.10)
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LARGE FORMAT PRINTER

Nonimpact printer that creates photo-realistic quality color prints; operates like an ink-jet printer, but on a much larger scale. (6.22)



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Web Instructions: To display this page from the Web, start your browser and enter the URL scsite.com/dc2002/ch6/learn.htm.

1. Web Guide

Click [Web Guide](#) to display the Guide to World Wide Web Sites and Searching Techniques Web page. Click Computers and Computing. Click PC Guide and then search for monitors. Click monitors and then review the information. Use your word processing program to prepare a brief report on your findings and submit your assignment to your instructor.

2. Scavenger Hunt

Click [Scavenger Hunt](#). Print a copy of the Scavenger Hunt page; use this page to write down your answers as you search the Web. Submit your completed page to your instructor.

3. Who Wants to Be a Computer Genius?

Click [Computer Genius](#) to find out if you are a computer genius. Directions on how to play the game will display. When you are ready to play, click the PLAY button. Submit your score to your instructor.

4. Wheel of Terms

Click [Wheel of Terms](#) to reinforce important terms you learned in this chapter by playing the Shelly Cashman Series version of this popular game. Directions on how to play the game will display. When you are ready to play, click the PLAY button. Submit your score to your instructor.

5. Career Corner

Click [Career Corner](#) to display the MSN Career page. Review this page. Click the links that you find interesting. Write a brief report on the topics you found to be the most helpful. Submit the report to your instructor.



6. Search Sleuth

Click [Search Sleuth](#) to learn search techniques that will help make you a research expert. Submit the completed assignment to your instructor.

7. Crossword Puzzle Challenge

Click [Crossword Puzzle Challenge](#). Complete the puzzle to reinforce skills you learned in this chapter. Directions on how to play the game will display. When you are ready to play, click the PLAY button. Submit the completed puzzle to your instructor.

8. Practice Test

Click [Practice Test](#). Answer each question. When completed, enter your name and click the Grade Test button to submit the quiz for grading. Make a note of any missed questions. If required, print a copy to submit to your instructor.



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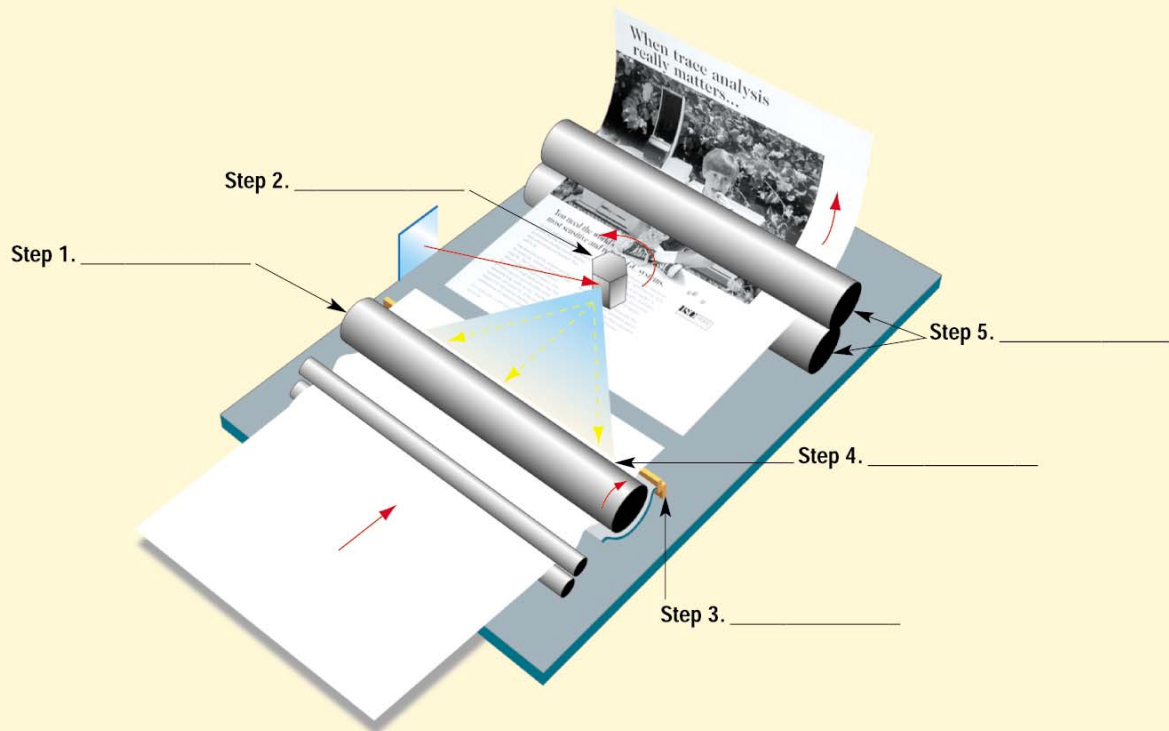
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LABEL THE FIGURE

Instructions: Identify each step in how a laser printer works.



MATCHING

Instructions: Match each term from the column on the left with the best description from the column on the right.

- _____ 1. thermal
- _____ 2. dot-matrix
- _____ 3. laser
- _____ 4. portable
- _____ 5. ink-jet

- a. Generates images by pushing electrically heated pins against [heat-sensitive paper](#).
- b. Uses heat to transfer colored dye to [specially coated paper](#).
- c. An [impact printer](#).
- d. Sprays droplets of ink to form [characters](#) and graphics.
- e. [Prints](#) an entire line at one time.
- f. [Processes](#) and stores the entire page before printing it.
- g. Lightweight printer for a [mobile user](#).

Checkpoint

Student Exercises

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Special Features

■ TIMELINE 2002

■ WWW & E-SKILLS

■ MULTIMEDIA

■ BUYER'S GUIDE 2002

■ WIRELESS TECHNOLOGY

■ TRENDS 2002

■ INTERACTIVE LABS

■ TECH NEWS



MULTIPLE CHOICE

Instructions: Select the letter of the correct answers for each of the following questions.

- [Output](#) is data that has been processed into a useful form, called _____.
 - ClearType
 - MPR II
 - information
 - gray scaling
- A [display device](#) _____.
 - displays in two colors on a black background
 - is an output device that visually conveys text, graphics, and video information
 - meets ENERGY STAR guidelines
 - none of the above
- A [display screen](#) that uses a separate transistor for each color pixel is a(n) _____.
 - dual-scan display
 - passive-matrix display
 - terminal
 - active-matrix display
- A [printer](#) produces _____.
 - soft copy
 - hard copy
 - both hard copy and soft copy
 - color depth
- Using _____, you can have a conversation over the [Web](#).
 - DLP
 - EMR
 - the ENERGY STAR program
 - Internet telephony



SHORT ANSWER

Instructions: Write a brief answer to each of the following questions.

- How is an [active-matrix display](#) different from a passive-matrix display? _____ What is a gas plasma monitor? _____
- How do LCD monitors and LCD displays present information on the screen? _____ What is a flat-panel display? _____ What is an electronic book ([e-book](#)) and how does it use ClearType? _____
- What is [high-definition television \(HDTV\)](#)? _____ What advantages does HDTV provide over analog signals? _____
- What is [monitor ergonomics](#)? _____ Why is monitor ergonomics important? _____ What is the ENERGY STAR program? _____
- How is a dumb terminal different from an [intelligent terminal](#)? _____ For what purpose is a point-of-sale terminal used? _____ What is a programmable terminal? _____



WORKING TOGETHER

Instructions: Working with a group of your classmates, complete the following team exercise.

A group of business employees would like to set up a small accounting office, with 10 to 12 employees. They have hired you and your group as consultants to help with the setup. Your primary responsibility is to determine the type of output devices you think they will need within the office. Items to consider are type and number of printers, type and number of display devices, audio and video devices, and whether fax machines, fax modems, and/or [multifunction devices](#) are needed. Use the Internet to research information for this project. Prepare a report to share with the class. Include a table listing the pros and cons of the various devices and a short explanation why you selected each device.

In The Lab

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Web Instructions: To display this page from the Web, start your browser and enter the URL scsite.com/dc2002/ch1/lab.htm. Click the links or current and additional information.

About Your Computer



This exercise uses Windows 98 procedures. Your computer probably has more than one output

device. To learn about the output devices on your computer, right-click the [My Computer icon](#) on the desktop. Click Properties on the shortcut menu. When the System Properties dialog box displays, click the Device Manager tab. If necessary, click View devices by type. Below Computer, a list of hardware device categories displays. What output devices display in the list? Click the plus sign next to each category. What specific output devices in each category are connected to your computer? Close the System Properties dialog box.



Accessibility Options

This exercise uses Windows 98 procedures. The [Windows](#)

[operating system](#) offers several output options for people with hearing or visual impairments. Three of these options are SoundSentry, ShowSounds, and High Contrast. To find out more about each option, click the Start button, point to Settings on the Start menu, and then click Control Panel on the Settings submenu. Double-click the Accessibility Options icon in the Control Panel window. Click the Sound tab in the Accessibility Properties dialog box. Click the Question Mark button on

the title bar, click SoundSentry, read the information in the pop-up window, and then click the pop-up window to close it. Repeat this process for ShowSounds. Click the Display tab. Click the Question Mark button on the title bar and then click High Contrast. Read the information in the pop-up window, and then click the pop-up window to close it. What is the purpose of each option? Click the Cancel button. Click the Close button to close the Control Panel window.

Self-Portrait



Windows includes a drawing program called [Paint](#). The quality of graphics produced with this

program depends on a variety of factors, including the quality of your printer, your understanding of the software, and (to some extent) your artistic talent. In this exercise, you use Paint to create a self-portrait. To access Paint, click the Start button, point to Programs on the Start menu, point to Accessories on the Programs submenu, and then click Paint on the Accessories submenu. When the Paint window opens, the Paint toolbox displays on the left side of the window. Point to a toolbox button to see a tool's name; click a button to use that tool. Use the tools and colors available in Paint to draw a picture of yourself. If you make a mistake, you can click Undo on the Edit menu to undo your most recent action, you can erase part of your picture using

the Eraser/Color Eraser tool, or you can clear the entire picture by clicking Clear Image on the Image menu. When your self-portrait is finished, print it by clicking Print on the File menu. Close Paint.



Magnifier

This exercise uses Windows 2000 procedures. Magnifier is a Windows [utility for](#)

[the visually impaired](#). To find out about the Magnifier capabilities, click the Start button on the taskbar and then click Help on the Start menu. Click the Index tab in the Windows 2000 window and then type magnifier in the Type in the keyword to find text box. Click the overview subentry below the Magnifier entry in the list of topics and then click the Display button. Click Magnifier overview in the Topics Found dialog box and then click the Display button. Read the Help information in the right pane of the Windows 2000 window and answer the following questions:

- How does Magnifier make the screen more readable for the visually impaired?
- What viewing options does Magnifier have?
- What tracking options does Magnifier have?

Click the Close button to close the Windows 2000 window.

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Web Instructions: To display this page from the Web, start your browser and enter the URL scs.site.com/dc2002/ch6/web.htm. To view At The Movies in exercise 1, RealPlayer must be installed on your computer (download by clicking [here](#)). To use the Shelly Cashman Series Setting Up to Print Lab and the Configuring Your Display Lab from the Web, Shockwave and Flash Player must be installed on your computer (download by clicking [here](#)).



E-Books

To view the E-Books movie, click the button to the left or click the Play button to the right. Watch the movie, and then complete the exercise by answering the questions below. Electronic books are here.

Holding a half-dozen novels, a semester's worth of textbooks, or a library of sales and service manuals, they promise a new world of portability, access, and convenience. Book files can be downloaded easily from the Internet. Prices range from \$300 to \$500 for the e-book itself, with thousands of titles currently available for \$5 to \$25 each. The technology and the market for e-books continue to improve in parallel. Better screens and voice recognition already are in the works. What other features might you suggest? What, if anything, do you think inhibits consumer acceptance of this technology?



Shelly Cashman Series Setting Up to Print Lab

Follow the appropriate instructions in Web Work 2 on page 1.47 to start and use the Shelly Cashman Series Setting Up to Print Lab. If you are running from the Web, enter the URL, www.scsite.com/sclabs/menu.htm; or display the Web Work page (see instructions at the top of this page) and then click the button to the left.



Shelly Cashman Series Configuring Your Display Lab

Follow the appropriate instructions in Web Work 2 on page 1.47 to start and use the Shelly Cashman Series Configuring Your Display Lab. If you are running from the Web, enter the URL, www.scsite.com/sclabs/menu.htm; or display the Web Work page (see instructions at the top of this page) and then click the button to the left.



Choosing a Monitor

The monitor is a key component of any new personal computer that you purchase. Everything you see is influenced by the monitor you select. Determining which monitor is best for your individual needs requires some research. Monitors are available in a range of sizes and a variety of resolutions. Click the button to the left for a tutorial on how to select the monitor that is best for your particular requirements.



In the News

Monitors continue to grow clearer and thinner. A newly introduced 50-inch gas plasma display presents near-photographic images and is less than four inches thick. At a cost of \$25,000, the monitors probably will be seen first at stadiums, in airports, and as touch screens in stores. Yet, as prices fall, consumers surely will purchase the monitors for HDTV and crystal-clear Internet access. Click the button to the left and then read a news article about a new or improved output device. What is the device? Who manufactures it? How is the output device better than, or different from, earlier devices? Who do you think is most likely to use the device? Why?

MULTIMEDIA

a VIRTUAL experience

Web Instructions: To gain World Wide Web access to additional and up-to-date information regarding this special feature, launch your browser and enter the URL shown at the top of this page.

INTERACTIVE MULTIMEDIA

Changing the Way People Work, Learn, and Play

Watch the Air Force Thunderbirds perform their daring aerobatic feats. Travel to Egypt and view King Tut's tomb. Watch the space shuttle blast into orbit. With multimedia, you can have all these adventures without setting foot outside your house (Figure 1). **Multimedia** refers to using computers to integrate text, graphics, animation, audio, and video into one application.

Unlike television, which combines and presents these media in a predefined order, most multimedia applications are interactive. Users participate directly with the application. **Interactive multimedia** presents information in various ways with a variety of media elements. Users choose the material to view, define the order in which it is presented, and obtain feedback on their actions. The computer accepts input through a keyboard, voice, or pointing device — such as a mouse — and performs an action in response.

Interactivity makes multimedia well suited for applications such as video games, flight simulators, virtual reality, electronic magazines, and educational and training tutorials. The multimedia application shown in Figure 2, for example, allows you to select from numerous geographical locations to learn about diving expeditions into the U.S. National Marine Sanctuaries and other regions.



Figure 1

Today, interactive multimedia plays an increasingly important role in business, industry, education, and entertainment.



MULTIMEDIA APPLICATIONS

A **multimedia application** uses technology for business, education, and entertainment. Businesses use multimedia, for example, in interactive advertisements and for job- and skill-training applications. Teachers use multimedia applications to deliver classroom presentations that enhance student learning.

Students, in turn, use multimedia applications to learn by reading, seeing, hearing, and interacting with the subject content. A wide variety of computer games and other types of entertainment also use multimedia applications.

Another important application of multimedia is to create **simulations**, which are computer-based models of real-life situations. Multimedia simulations often replace costly and sometimes hazardous demonstrations and training in areas such as chemistry, biology, medicine, and aviation.

The following sections provide a more detailed look at the various types of multimedia applications, such as business presentations, computer- and Web-based training, distant learning, classroom and special education, electronic books and references, how-to guides, and newspapers and magazines. These sections also address the use of multimedia for entertainment and edutainment, virtual reality, and kiosks, as well as its importance on the World Wide Web.

Business Presentations

Many businesses and industries use multimedia to create marketing presentations that advertise and sell products. Advertisers, for instance, save time and money by using this software to produce television commercials with unique media effects. Sales representatives also use multimedia in marketing presentations created using presentation graphics software. To deliver these presentations to a large audience, users can connect their computer to a video projector that displays the presentation on a full screen (Figure 3).



Figure 3

Video projectors connected to a computer can display images brightly and clearly. Some projectors are as small and lightweight as a notebook computer.

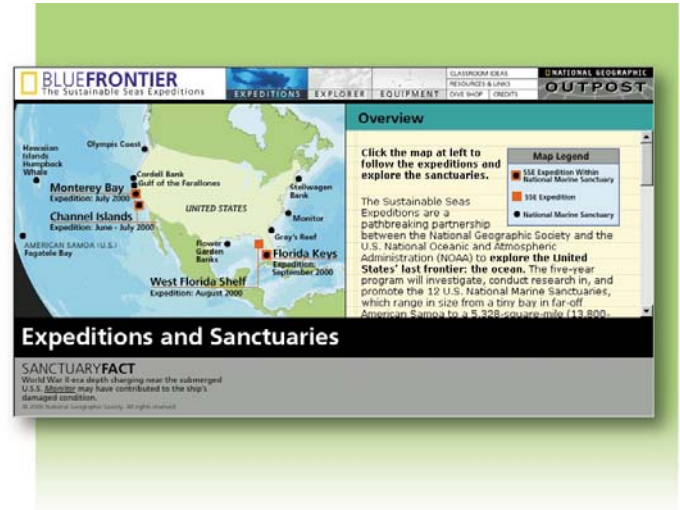


Figure 2

This National Geographic Web site consists of text, graphics, and links to diving expeditions.

WORK • LEARN • PLAY

Computer-Based Training

Students use **computer-based training (CBT)** to learn and complete exercises with instructional software, such as the Learn By Series shown in Figure 4. Also called **computer-aided instruction (CAI)**, computer-based training is popular in business, industry, and schools to teach new skills or to enhance the existing skills of employees, teachers, or students. Athletes, for example, use multimedia computer-based training programs to learn the intricacies of baseball, football, soccer, tennis, and golf, while airlines use multimedia CBT simulations to train employees for emergency situations. Schools use CBT to train teachers in various disciplines and to teach students math, language, and software skills. Interactive CBT

software called **courseware** usually is available on CD-ROM or DVD-ROM or shared over a network.

Computer-based training allows for flexible, on-the-spot training. Businesses, for example, can set up corporate training labs, so employees can update their skills without leaving the workplace. Installing CBT software on an employee's computer or on the company network provides even more flexibility by allowing employees to update their job skills at their desks, at home, or while traveling.

Computer-based training provides a unique learning experience because learners receive instant feedback in the form of positive responses for correct answers or actions, additional information on incorrect answers, and immediate scoring and results. Testing and self-diagnostic features allow instructors to verify that a learner has mastered curriculum objectives and identify those who need additional instruction or practice. CBT is especially effective for teaching software skills if the CBT is integrated with the software application because it allows students to practice using the software as they learn.

Some of the many other advantages of CBT over traditional training include self-paced study, reduced training time and costs, and unique multimedia content. Many CBT trainers find they can increase their time helping trainees because computers handle test delivery and grading.

Some of the many other advantages of CBT over traditional training include self-paced study, reduced training time and costs, and unique multimedia content. Many CBT trainers find they can increase their time helping trainees because computers handle test delivery and grading.

Web-Based Training (WBT) and Distance Learning

Web-based training (WBT) is an approach to computer-based training (CBT) that employs the technologies of the Internet and the World Wide Web. As with CBT, Web-based training typically consists of self-directed, self-paced instruction on a topic. Because it is delivered via the Web, however, WBT has the advantage of being able to offer up-to-date content on any type of computer platform.

During the past few years, the number of organizations using Web-based training has exploded. Today, many major corporations in the United States provide employees with some type of Web-based training to teach new skills or to upgrade their current skills.

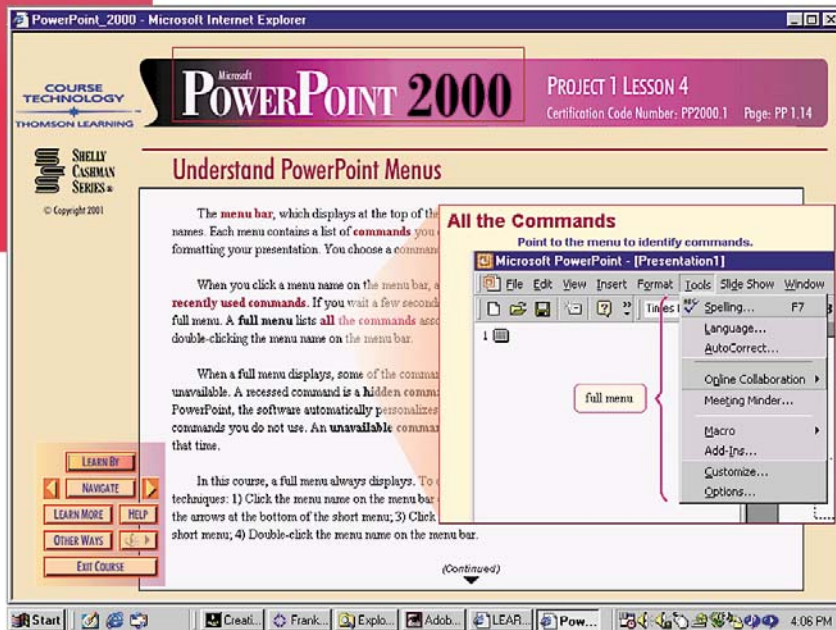


Figure 4
Computer-based training, such as the Learn By Series, is designed so students can choose learning activities that complement their learning styles.

Web-based training, computer-based training, and other materials often are used as materials for distance learning courses. **Distance learning**, also called **distance education**, is the delivery of education from one location while the learning takes place at other locations. Some national and international corporations also save millions of dollars by using distance learning to train employees, thus eliminating the costs of airfare, hotels, and meals for centralized training sessions.

Many colleges and universities offer numerous distance learning courses, usually in the form of Web-based or Web-enhanced courses (Figure 5). Web-based courses offer many advantages for students who live far from a college campus or work full time, allowing them to complete coursework from home or at any time that fits their schedules. A number of colleges and universities now offer master's and doctorate degree programs in which every required course is taught over the Web.

Web-based training also is available for individuals at home or at work. Today, anyone with access to the Web can take advantage of hundreds of multimedia tutorials offered online. Such tutorials cover a wide range of topics, from how to change a flat tire to creating presentations in Microsoft PowerPoint. Many of these Web sites are free (Figure 6); others ask users to register and pay a fee to take the complete Web-based course.

Classroom and Special Education

Multimedia applications are used to teach students of all ages. From interactive CD-ROMs and DVD-ROMs to presentations, multimedia can be an effective tool for delivering educational material to potential learners, making learning more exciting and interesting. Often, isolated rural schools are leaders in connecting classrooms to the Internet and using multimedia applications to enhance learning.

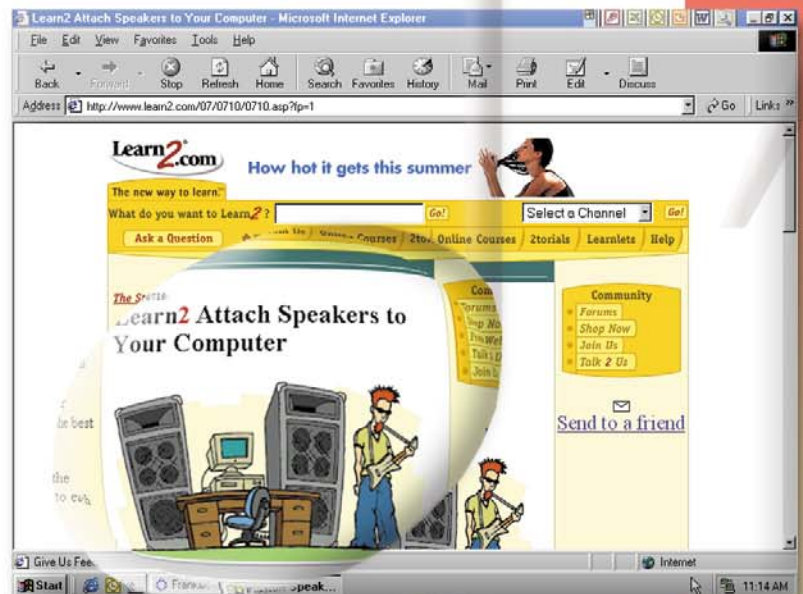
Figure 5

Many colleges and universities offer some of their classes in a distance learning format.



Figure 6

This Learn2 2torial explains how to install the best sound for your computer system in 10 minutes. The Web site offers practical and straightforward steps for a variety of activities on such diverse topics as obtaining a line of credit and repairing a surfboard ding.



This software makes the learning process more interesting, allows students to perform experiments in a risk-free environment, and provides instant feedback and testing. Virtual dissection of a frog is possible, for example, as shown in Figure 7. CBT also appeals to various learning styles and provides a new type of learning experience. A student using a CBT study guide, for example, could listen to a speaker reciting French vocabulary to help with the pronunciation of difficult words. You can buy many CBT programs such as these on CD-ROM or DVD-ROM from a local retailer or merchant on the Web.

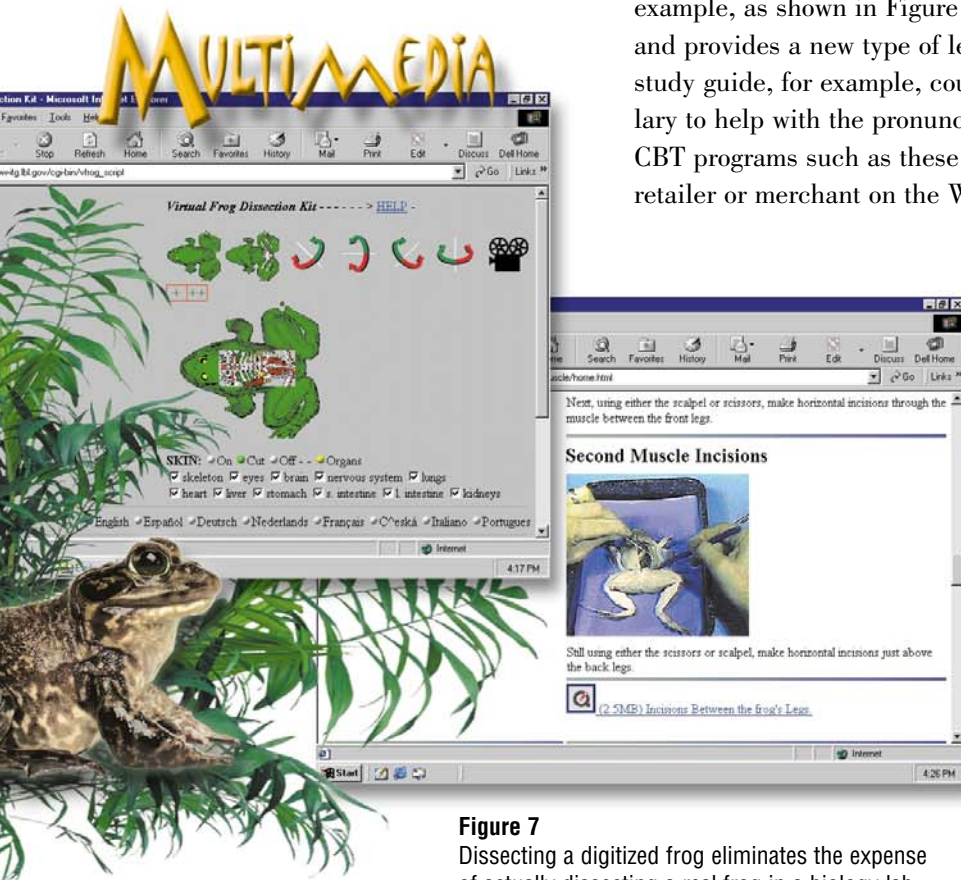


Figure 7
Dissecting a digitized frog eliminates the expense of actually dissecting a real frog in a biology lab. These interactive programs allow you to view and remove organs and to make a movie of your progress. The Web pages are available in various languages.

Research has shown that, when properly evaluated and integrated into teaching at the point of instruction, multimedia applications are a highly effective teaching tool. When using a multimedia application, students become actively involved in the learning process instead of passive recipients of information. Interactive multimedia applications engage students by asking them to define their own paths through an application, which often lead them to explore many related topics.

Multimedia applications also are well suited for both physically impaired and learning disabled students. Students who are visually impaired, for example, benefit from the audio capabilities of multimedia applications, as well as the use of graphics and larger font sizes (Figure 8). Visual materials, such as graphics, animation, and video, also make learning easier for students who are hearing impaired. Many educational software companies offer multimedia products with closed captioning or sign language to enhance the learning experience for hearing-impaired students. The ability of individuals to work, practice, and review at their own pace is a major benefit for the learning disabled.



FIGURE 8
Physically impaired and learning disabled students benefit from multimedia software rich in graphics, animation, and video. These students are using software developed by ClickIt!, which allows them to choose objects on the screen without using a mouse.

Electronic Books

One type of **electronic book** is a digital text that gives the user access to information through links, which often are bold or underlined words. These electronic books have many of the elements of a regular book, including pages of text and graphics. Users generally click icons to turn pages of this type of electronic book. A table of contents, glossary, and index also are available at the click of a button. To display a definition or a graphic, play a sound or a video sequence, or connect to a Web site, users simply can click a link.

A newer type of electronic book, called an **e-book**, uses a small book-sized computer that can hold up to 4,000 pages, or about 10 book's worth of text and small graphics. By clicking a button, users move forward or backward, add notes, and highlight text stored in the e-book. Figure 6-7 on page 6.7 shows a photograph of an e-book. Readers also can view e-books on a small personal computer, such as a Palm™ handheld computer, with the text supplied from various sources. One of these sources is **Project Gutenberg**, which makes thousands of literary and reference books and materials available free to the general public (Figure 9).

Publishers are developing innovative methods of getting authors' words to the public. Some publishers, for example, create purely digital books sold online or in single copies when customers place orders through online booksellers' and organizations' Web sites. These e-books are not sold in bookstores. For example, readers desiring chapters of Stephen King's novel, *The Plant*, ordered them for \$1 each through Amazon.com. Other publishers are creating **electronic paper**, which feels like real paper but is coated with electronic ink so that the characters can change. When you finish reading one of these books, you can plug it into a telephone line or a wireless receiver and then download another book.

Electronic Reference Texts

An **electronic reference text**, sometimes called an **e-text**, is a digital version of a reference book, which uses text, graphics, sound, animation, and video to explain a topic or to provide additional information. The multimedia encyclopedia, Microsoft Encarta, for example, includes the complete text of a multivolume encyclopedia. In addition to text-based information, Microsoft Encarta includes thousands of photographs, animations, audio and video clips, and detailed illustrations (Figure 10). This array of multimedia information is accessible via menus and links.

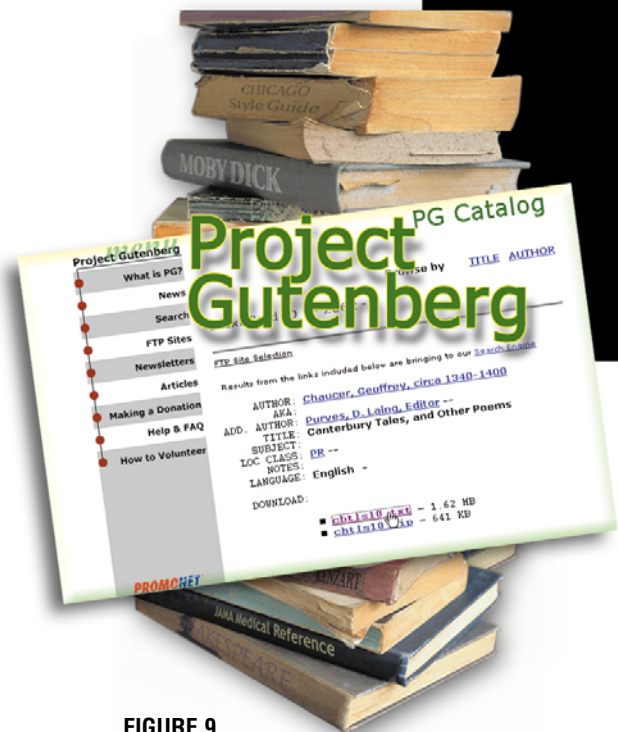


FIGURE 9

Geoffrey Chaucer's *Canterbury Tales* is among the thousands of public domain reference and literary works available from Project Gutenberg. One new book is added to the Web site almost daily.

FIGURE 10

Microsoft Encarta is a popular multimedia encyclopedia that includes graphics, audio, video, and Web links.



Many other reference texts are used in a variety of fields and professions (Figure 11). Health and medicine are two areas in which multimedia reference texts play an important role. Instead of using volumes of books, health professionals and students rely on reference CD-ROMs and DVD-ROMs for information, illustrations, animations, and photographs on hundreds of health and first-aid topics.

ELECTRONIC REFERENCE TEXTS			
Name	Publisher	URL	Description
American Heritage Talking Dictionary	Compton's NewMedia, Inc.	www.comptons.com	Uses a human-sounding voice to pronounce more than 90,000 words; contains more than 200,000 definitions, an integrated thesaurus, and 3,000 images, photographs, maps, and flags.
Compton's® Encyclopedia	Compton's NewMedia, Inc.	www.comptons.com	Features more than 40,000 articles, interactive science activities, monthly updates via the Internet, 360-degree views and virtual tours, more than 8,000 photos, and 100 videos, animations, and slide shows.
Encarta Encyclopedia Deluxe	Microsoft	microsoft.com	Contains more than 42,000 articles, 170 videos and animations, a natural language search function, a dynamic timeline, virtual tours, 360-degree views, and text-to-speech capabilities.
Library of the Future	AbleSoft	kidsoft.com	Contains descriptions of more than 5,000 literary works, authors' biographies, and film clips.
American Sign Language for Kids	Multimedia 2000	m-2k.com	Uses text, QuickTime video, animations, and illustrations to teach 2,600 signs, and includes learning games and lessons on fingerspelling.

For an updated list of electronic reference text Web sites, enter the URL at the top of this page.

FIGURE 11 These e-texts use multimedia to clarify topics and supply additional information on thousands of subjects.

How-To Guides

Numerous interactive multimedia applications are available to help individuals in their daily lives. These multimedia applications fall into the broad category of how-to guides. **How-to guides** are multimedia applications that include step-by-step instructions and interactive demonstrations to teach practical new skills (Figure 12). Much like the

computer-based training applications used by businesses, how-to guides allow users to acquire and test new skills in a risk-free environment. The skills learned with a how-to guide, however, usually are oriented toward personal enrichment, rather than workplace skills.

How-to guides can help with activities such as buying a home or a car, designing a garden, planning a vacation, improving a home, and repairing a car or computer. The CD-ROM how-to-guides listed in Figure 13 show the wide variety of instructional guides. Multimedia how-to guides also are available on DVD-ROM and the Web.

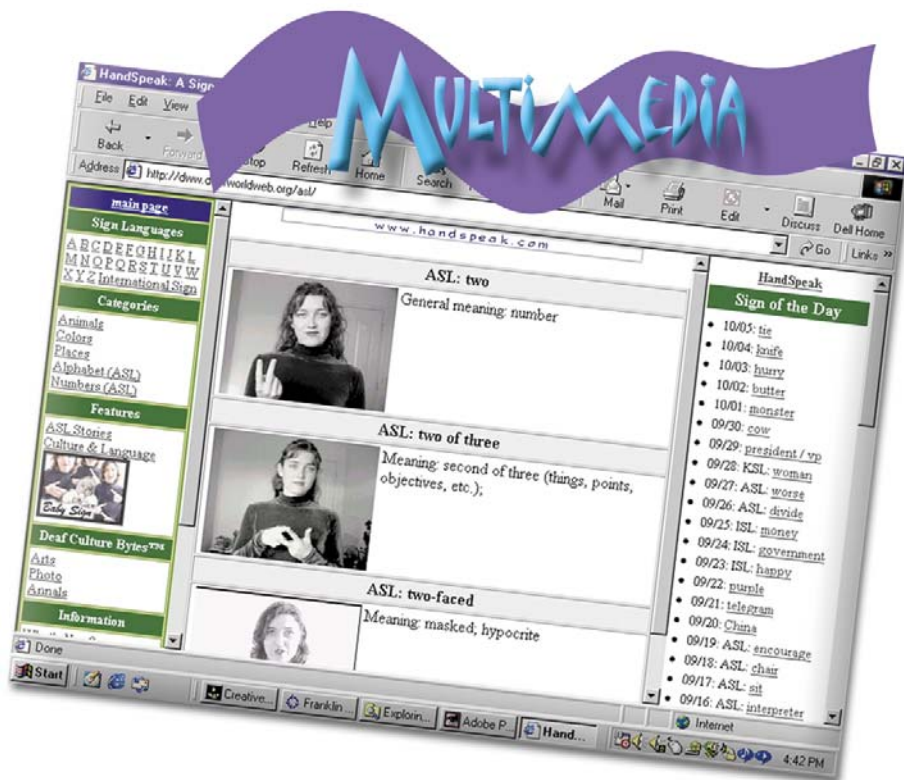


FIGURE 12

Web users can learn American Sign Language via the HandSpeak online dictionary. This Web site features video clips of individuals signing words, including words with several definitions.

CD-ROM HOW-TO GUIDES			
Name	Publisher	URL	Description
3D Home Architect®	Mattel Interactive™	www.mattelinteractive.com	Customize floor plans and then view your 3-D design. The plans analyze climate, community growth, and zoning ordinances.
Cosmopolitan™ Virtual Makeover™	Mattel Interactive™	www.mattelinteractive.com	Input your photograph and change your image by experimenting with 500 hairstyles, 300 cosmetic colors, and 200 accessories. You can save, print, and send as e-mail attachments.
Complete LandDesigner 3D	SierraHome Network	sierra.com/sierrahome	Design a garden or yard by choosing from 6,000 trees, shrubs, flowers, and vines or by viewing sample gardens, and then view the plants as they grow and change with the seasons. A 3-D feature lets virtual gardeners view their creations from any angle.
MasterCook Deluxe	SierraHome Network	sierra.com/sierrahome	Prepare one of 5,000 dishes based on nutritional value and ingredients on hand. Watch instructional videos, and adjust the portions to the number of servings needed.
Teach Yourself PC Maintenance	Learn2.com, Inc.	learn2.com	Learn such computer concepts as motherboard ports, the OS and processor, hardware, installing SIMMs, modem standards, baud vs. bit rates, maintenance tools, keyboard cleaning, and the ScanDisk utility from four interactive multimedia CD-ROM tutorials.

For an updated list of CD-ROM how-to guide Web sites, enter the URL at the top of this page.

FIGURE 13

These how-to guides teach useful skills by using videos, interactive demonstrations, and animations.

Newspapers and Magazines

A **multimedia newspaper** and a **multimedia magazine** are digital versions of a newspaper or magazine distributed on CD-ROM, DVD-ROM, or via the World Wide Web. Today, many print-based magazines and newspapers have companion Web sites that provide multimedia versions of some or all of their printed content (Figure 14). An **electronic magazine**, or **e-zine**, is a digital publication available via the Web (Figure 15 on the next page).

Multimedia newspapers and magazines usually include the sections and articles found in their print-based versions, including departments, editorials, and more. Unlike printed publications, however, multimedia magazines and newspapers use many types of media to convey information. Audio and video clips, for example, can showcase recent album or movie releases, and animations can depict weather patterns or election results.

MULTIMEDIA MAGAZINES AND NEWSPAPERS	
Name	URL
Independent Newspapers (South Africa)	iol.co.za
Kyodo News (Tokyo)	home.kyodo.co.jp
National Geographic	nationalgeographic.com
Newsweek	newsweek.msnbc.com
The Daily Telegraph (London)	www.telegraph.co.uk
The Globe and Mail (Canada)	globeandmail.ca
The New York Times	nytimes.com
The Wall Street Journal	wsj.com
Time	time.com
USA TODAY	usatoday.com
Washington Post	washingtonpost.com

For an updated list of multimedia magazine and newspaper Web sites, enter the URL at the top of this page.

FIGURE 14

Multimedia magazines and newspapers from various countries use video and audio clips, animations, and other interactive multimedia tools to bring the world to personal computers.

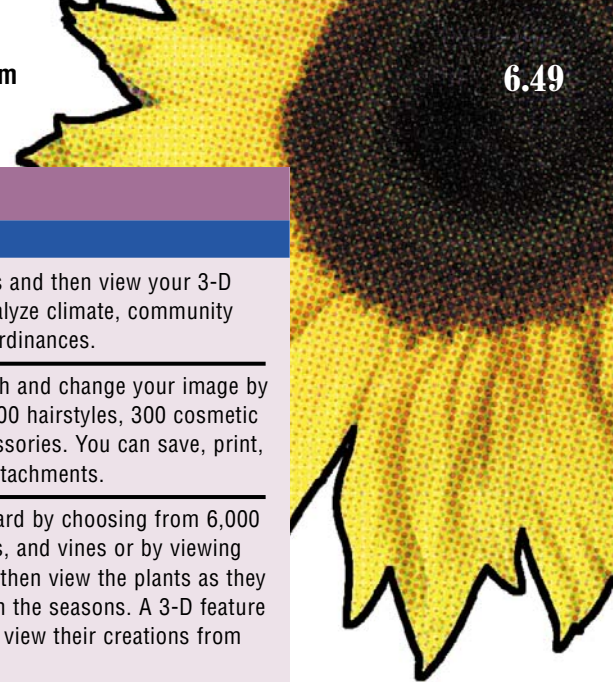




FIGURE 15
E-zines are produced for the Web and often contain multimedia applications.

E-ZINES

Name	URL	Description
AMC's American Pop!	ampop.com	Programming devoted to vintage music, movies, toys, fashions, and pop culture. Shockwave and Flash are used extensively.
OS/2 eZine	www.os2ezine.com	Articles and forums focusing on IBM's OS/2 multitasking operating system.
The Western Flyfisher	westernflyfisher.com	Numerous audio and video clips for flyfishing enthusiasts.
WebReference.com	webreference.com	Reference material on a wide variety of Web topics, including effective authoring, browsing, coding HTML, and designing Web sites.
ZENtertainment	zentertainment.com	Latest entertainment news, including sections for music, TV, movies, toys, comics, and food.

For an updated list of e-zines Web sites, enter the URL at the top of this page.

Entertainment and Edutainment

Multimedia combines the media elements of television and interactivity, thus making it ideal for entertainment. Multimedia computer games, for example, use a combination of graphics, audio, and video to create a realistic and entertaining game situation. Often the game simulates a real or fictitious world, in which users play the role of a character and have direct control of what happens in the game. The music industry also sells interactive multimedia applications on CD-ROM and DVD-ROM. Some interactive music CD-ROMs, for example, allow budding musicians to play musical instruments along with their favorite musician, read about the musician's life and interests, and even create their own versions of popular songs. Like interactive games, these applications give users a character role and put them in control of the application (Figure 16).



FIGURE 16
Entertainment applications, rich in multimedia content, provide fun and relaxation for children and adults.

ENTERTAINMENT APPLICATIONS

Name	Publisher	URL	Description
Backyard Baseball	Humongous Entertainment	humongous.com	Select players from 30 Major League Baseball teams or create your own team colors, ballpark, and strategy. Play online with other Windows users.
Dogz®	Mattel Interactive™	www.mattelinteractive.com	Use voice recognition to train your Dogz to sit, fetch, or roll over; create custom scenes with the Play Scene Editor.
Motocross Madness	Microsoft	microsoft.com	Perform stunts on your motorbike while you race up to eight opponents online via the MSN Gaming Zone.
RollerCoaster Tycoon™	Hasbro Interactive	hasbro-interactive.com	Use 14 styles to construct roller coasters with accurate motion dynamics and physics principles. Analyze their excitement and nausea ratings.
The Sims	Electronic Arts	thesims.com	Develop characters in a neighborhood, build their homes, and display your creations on the World Wide Web with these open-ended games.

For an updated list of entertainment application Web sites, enter the URL at the top of this page.

Other multimedia applications are used for **edutainment**, which is an experience meant to be both educational and entertaining. Many edutainment CD-ROMs and DVD-ROMs provide content for individuals of all ages, while others are created specifically to teach children in a fun and appealing way. Some of these edutainment applications are listed in Figure 17.

EDUTAINMENT APPLICATIONS			
Name	Publisher	URL	Description
Carmen Sandiego	Mattel Interactive	www.mattelinteractive.com	Discover geography by searching for criminals in various locales using foreign languages and Internet links to maps and satellite pictures. The police chief gives updates using real-time video.
James Cameron's Titanic Explorer	20th Century Fox	foxinteractive.com/games/titanicexplorer	Witness James Cameron's diving expedition of the Titanic and use interactive 3-D models to examine the ship and the wreck. View a computer simulation of how the ship sank, and then browse through more than 1,200 pages of survivors' testimony.
Kaplan GMAT, LSAT, and GRE™	Encore Software	encoresoftware.com	View personalized interactive lessons and links to graduate schools.
Reader Rabbit	Mattel Interactive	www.mattelinteractive.com	Teaches young children problem solving, decision making, and logic skills; learning technology monitors performance, offers help, and prints reports.
The New Way Things Work	DK Multimedia	www.dk.com	Discover how more than 150 machines work by viewing animations, illustrations, and videos.

For an updated list of edutainment application Web sites, enter the URL at the top of this page.



FIGURE 17
Edutainment applications offer adults and children both education and entertainment.

Virtual Reality

Virtual reality (VR) is the use of a computer to create an artificial environment that appears and feels like a real environment and allows users to explore a space and manipulate the surroundings (Figure 18). In its simplest form, a virtual reality application displays a three-dimensional view of a place or object, such as a landscape, building, molecule, or red blood cell, which users can explore. Architects use this type of software to show clients how a building will look after a construction or remodeling project.

In more advanced forms, VR software users wear specialized headgear, body suits, and gloves to enhance the experience of the artificial environment (Figure 19). The headgear displays the artificial environment in front of both eyes. The body suit and the gloves sense motion and direction, allowing users to move, pick up, and hold virtually displayed items. Experts predict that eventually the body suits will provide tactile feedback, so users can experience the touch and feel of the virtual world.

Your first encounter with VR likely will be a virtual reality game such as a flight simulator. In these games, special

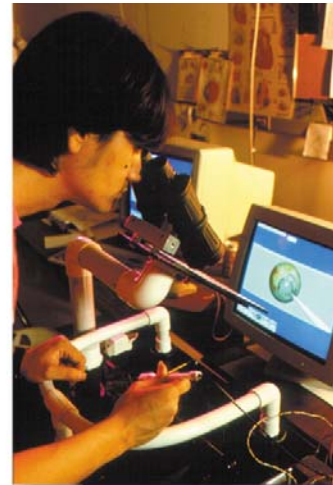


FIGURE 18
A virtual reality system, which includes a stereomicroscope, helps a researcher practice eye surgery.

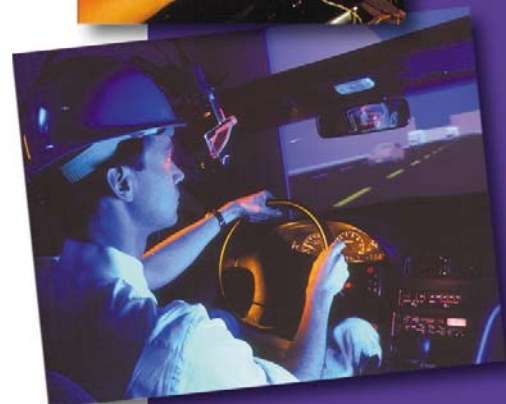


Figure 19
Nissan designers testing a virtual reality system in an effort to reduce accidents.

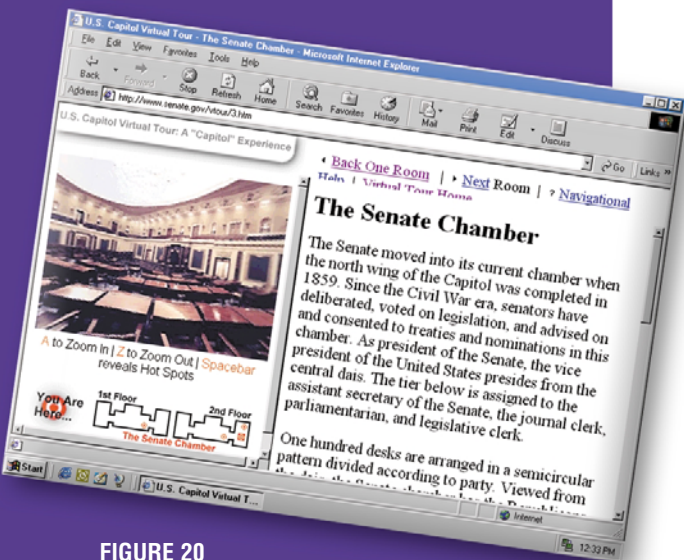


FIGURE 20

The U.S. Capitol Virtual Tours Web site gives visitors 360-degree views of the Senate and House of Representative chambers, also included are details about objects found in those rooms and historical information.

FIGURE 21

Lexus is one of the auto manufacturers that allows Internet users to build a specific car, including selecting colors and accessories, and then price their designed vehicle. Nearly one-half of U.S. households that buy vehicles turn to the Internet to research their purchases.



visitors allow you to see the computer-generated environment. As you walk around the game's electronic landscape, sensors in the surrounding game machine record your movements and change your view of the landscape accordingly. You also might use a Web-based VR application developed using **virtual reality modeling language (VRML)**. Web sites, such as the U.S. Capitol Web site shown in Figure 20, use virtual reality to allow you to take tours of a city, view real estate for sale, or interact with local attractions.

Some companies use VR for more practical, commercial applications, as well. Automobile companies, for example, have created virtual showrooms in which customers can view the exterior and interior of vehicles (Figure 21). In addition, airplane manufacturers are using virtual prototypes to test new models and shorten product design time. Telecommunications firms use personal computer-based VR applications for employee training. As computing power and the use of the Web increase, practical applications of VR will continue to emerge in education, business, and entertainment.

Kiosks

A **kiosk** is a computerized information or reference center that allows users to select various options to browse through or find specific information. A typical kiosk is a self-service structure equipped with computer hardware and software. Kiosks often use touch screen monitors or keyboards for input devices and contain all of the data and information needed for the application stored directly on the computer.

Kiosks often provide information in public places where visitors or customers have common questions. Locations such as shopping centers, airports, museums, and libraries, for example, use kiosks to provide information on available services, product and exhibit locations, maps, and other information (Figure 22). Kiosks also are used for marketing. A kiosk might contain an interactive multimedia application that allows you to try options and explore scenarios related to a product or service. For example, you might be able to try different color combinations or take short quizzes to determine which product best meets your needs. The interactive multimedia involves customers with the product, thus increasing the likelihood of purchase.

FIGURE 22

Seattle's Woodland Park Zoo features an interactive kiosk for its *Touch the Earth . . . Gently* exhibit. The 11-by-9-foot exhibit contains a laser disc player, touch screen monitor, and counters that calculate the net gain in world population and the net loss of wild animals' habitats.

The World Wide Web

Multimedia applications also play an important role on the **World Wide Web**, which is the part of the Internet that supports multimedia. In fact, much of the information on the Web today relies on multimedia. Using multimedia brings a Web page to life, increases the types of information available on the Web, expands the Web's potential uses, and makes the Internet a more entertaining place to explore. As described in Chapter 2, the Web uses many types of media to deliver information and enhance a user's Web experience (Figure 23). Graphics and animations reinforce text-based content and provide updated information. Online radio stations, movie rental Web sites, and games use audio and video clips to provide movie and music clips or to deliver the latest news.

Many of the multimedia applications previously described, including computer- and Web-based training, newspapers, e-zines, games, and virtual reality, are deliverable via the Web. New multimedia authoring software packages include tools for creating and delivering multimedia applications via the World Wide Web. Some of these authoring software packages allow users to create applications in the Windows environment and then convert them to HTML and Java for Web use.

DEVELOPING MULTIMEDIA APPLICATIONS

You can create a multimedia application using a variety of software applications. With PowerPoint, for example, you can create a presentation that combines text, graphics, animation, and audio and video clips (Figure 24). Developing these applications follows a standard process with several phases. While some



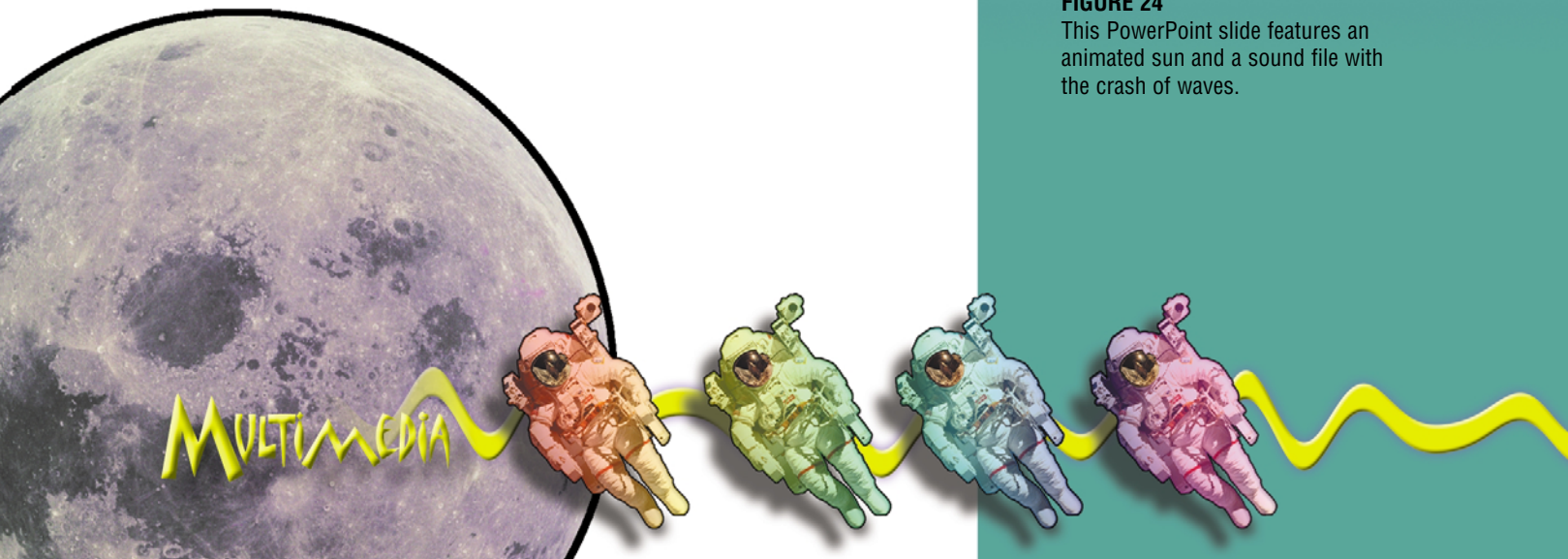
FIGURE 23

CNN is one of the many Web sites that incorporates multimedia features to report daily news events, weather, health tips, and entertainment.



FIGURE 24

This PowerPoint slide features an animated sun and a sound file with the crash of waves.



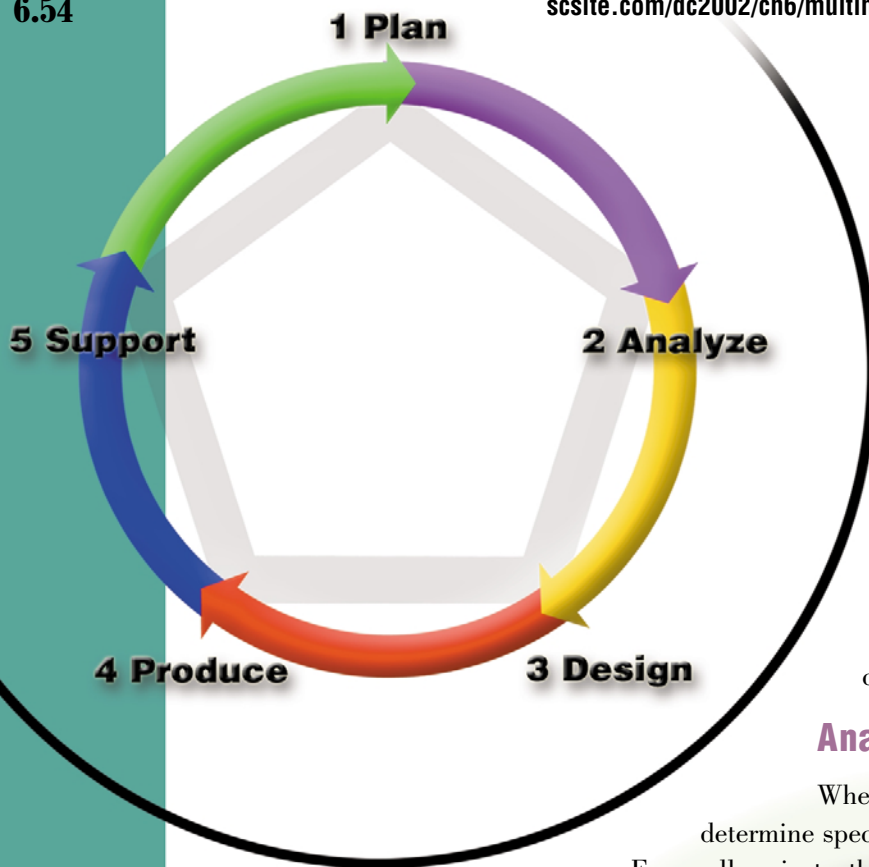


FIGURE 25
Developing effective multimedia presentations involves a five-step process.



of the terminology is different, the basic activities completed within each phase closely follow those of the program development life cycle: plan, analyze, design, produce, and support (Figure 25).

Plan

The first step in developing multimedia applications is to **plan** the project. This phase requires reviewing the application's goal, allocating resources, and identifying individuals who will participate on the project development team. Larger projects, such as commercial CD-ROM and DVD-ROM products, usually involve a project team, including a producer, an art director, an interface designer, a content designer, and the programmer.

Analyze

When team members carefully **analyze** the project, they determine specific objectives and requirements for the application. For small projects, the developer may play a variety of roles, which may include content developer, interface designer, and programmer. For larger projects with specific learning objectives, analysis is extremely important.

Design

Once basic requirements have been determined, the **design** phase begins. A vital tool for the project team is a flowchart, or map, which includes all of the various media elements in the application and serves as a blueprint to which the project team or individual developer can refer. Another important tool is the **project script**, which provides detailed information to supplement the flowchart and records how the various media elements will be used in the production. Screen design is another crucial part of designing an effective multimedia application. The colors and layout used for individual screens greatly influence the overall effect of the finished product.

Produce

Project team members **produce** the multimedia application by creating the various media elements used in the application and combining them using multimedia authoring software. Artists develop original graphics and animations using drawing and illustration software, add photographs by using a digital camera, a PhotoCD, or a scanner, and record digital video and audio clips using recording devices and a video capture or sound card. Authoring begins when they have obtained all of the media elements. Finally, the developer tests the program to verify it performs according to design specifications.

Support

During the **support** phase, the developer reviews the project to ensure all objectives have been met. In addition, errors are identified and corrected. At this point, plans may be made to modify or enhance the application with additional features. If so, the cycle begins again at the planning phase.

Multimedia Authoring Software

Developing an interactive multimedia application involves using **multimedia authoring software** to combine text, graphics, animation, audio, and video into an application. Authoring programs also allow you to design interactive areas on the screen that respond to user input. Once various media elements are added to the program, the multimedia authoring software assigns relationships and actions to elements. The programs also help create a structure that lets the user navigate through the material presented.

One of the more important activities of the production phase of multimedia development is selecting the multimedia authoring software package. Factors to consider when selecting a multimedia authoring software package are quality of application developed, ease of use, clear documentation, responsiveness of vendor’s service and technical support, compatibility with other applications, ease of programming, functionality, and system requirements for both user and developer.

Most popular authoring packages share similar features and are capable of creating similar applications. The major differences exist in the ease of use for development. Four popular multimedia authoring packages — Authorware, Director, Flash, and ToolBook — are described in Figure 26. Developers can use these products to create spectacular Web sites.

FIGURE 26
These popular multimedia authoring software packages allow users to create interactive elements that respond to user input.

MULTIMEDIA AUTHORING SOFTWARE			
Product	Publisher	URL	Use
Authorware	Macromedia	macromedia.com	Uses flowchart metaphor to build a multimedia application.
Director	Macromedia	macromedia.com	Uses a theater or movie production metaphor to build a multimedia application. Three integrated windows — Cast, Score, and Stage — are used to create and sequence text and other media elements.
Flash	Macromedia	macromedia.com	Creates dazzling Web sites that display across a user's entire screen — regardless of monitor size — and include input, interactivity, sounds, music, graphics, and animations.
ToolBook	click2learn.com	click2learn.com	Uses a graphical user interface and an object-oriented approach to design applications using basic objects such as buttons, fields, graphics, backgrounds, and pages.

For an updated list of multimedia authoring software Web sites, enter the URL at the top of this page.

FEATURE SUMMARY

Interactive multimedia distributed on CD-ROM, DVD-ROM, and via the World Wide Web influences people’s everyday experiences in the workplace, at school, and in recreational activities. In today’s office, employees and clients prepare and view multimedia business presentations. Using drill-and-practice or exploration activities, learners of all ages are able to define their own learning paths, investigate topics in depth, and get immediate feedback. Students gain knowledge of the world in and out of the classroom using computer-based training, Web-based training, distance learning, electronic books and reference texts, how-to guides, virtual reality, and multimedia magazines and newspapers. Entertainment and edutainment interactive multimedia programs enrich the way people relax and have fun. Interacting with well-designed multimedia applications is a positive experience and engages and challenges users, thus encouraging them to think independently and creatively.

